Foreclosure discounts and spillover effects: An assessment of market efficiency in the residential real estate market of Amsterdam from the 16th to 19th century

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Abstract - This thesis uses the historical setting of Amsterdam to investigate the presence of foreclosure discounts and the effect of foreclosures on neighboring properties. Based on a unique archival dataset with more than 164,000 transactions, I investigate foreclosure discounts, the time variation of foreclosure discounts and spillover effects via applying a cross-methodological approach from 1509 until 1811. This thesis exploits the high detail grade of the provided microdata to combine qualitative analysis of microdata with quantitative analysis based on a repeat sales methodology in a time period, with a unique foreclosure process. I find that the residential real estate market of Amsterdam has been very efficient, this might in part be explained by the reduced uncertainty of the Anglo-Dutch premium auction and the time-specific demand-supply dynamics that caused in wide parts of the sample a demand overhang. In terms of time variation, I find significant time variation of foreclosure discounts that seemingly are negatively correlated to the real estate cycle. A quantitative analysis of the relation between the real estate cycle and foreclosure discounts did not yield significant results, hence the relation remains subject to further research. Combining the microdata of the sample with a quantitative analysis I develop the hypothesis that this time variation might in part be driven by supply and demand relations but also by significant quality differences arising from changes in maintenance levels. I also investigate the spillover effects of foreclosures on neighboring properties, here I find significant spillover effects, that vary in terms of economic magnitude with street sizes.

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1. Introduction

This thesis analyses foreclosure discount in a historic setting, using the residential real estate market of Amsterdam from 1509 until 1811 to assess the existence of foreclosure discounts and spillover effects of real estate foreclosure discounts on neighboring properties.

This topic gained attention after the housing crisis 2008 in the United States and was the topic of much recent literature. Campbell et al. (2011) find an average foreclosure discount of 27% relative to the value of the house, using a hedonic regression in a dataset of 1.8 million transactions in Massachusetts and significant spillover effects. They find a spillover effect that suggests, that each foreclosure that takes place 0.05 miles away lowers the price of a house by about 1%. This means that 2 houses which show the same hedonic characteristics (excluding the sales method) sell for different prices when one is sold as a foreclosure and one is sold normally. As foreclosure discounts are an indicator of a market inefficiency or at least process inefficiency it should be of academic interest, even more so when such a market inefficiency causes spillover effects that magnify the market inefficiency.

Next to academic interest, foreclosure discount have implications for optimal LTVs (Loan-to-value ratios) and spillover effects of foreclosures imply a significant challenge for regulators and economists, as significant spillover effects reinforce residential real estate crises. This is a consequence of the strong link between residential real estate markets with credit cycles and thus the indirect link with business cycles (Jordà et al. 2014). In this context spillover effects will in a scenario like in 2008, where the number of foreclosures in the United States increased by 79% from 650,000 in the first half of 2007 to 1.2 million foreclosures in the first half of 2008 (Mayer et al. 2009), substantially impact the overall economic well-being via decreasing real estate values. Decreased real estate values, on the one hand reduce, the overall wealth level but on the other hand decreases recovery rates on defaulting real estate credits, which will materialize in worsening financial wellbeing of lenders. The worsening financial wellbeing of lenders will limit the supply of credit for new properties and consequently, reduce demand and hence reduce market liquidity.

The collapse in the United States [U.S.] housing market following the financial crisis in 2008 led to a 35% drop in house prices and an increase in mortgages with defaulting payments that reached over 10% in 2009. Mortgage contracts allow lenders to foreclose on a home when the homeowner defaults on his payment obligations (Mian et al. 2015). Consequently when major shocks hit the economy and lead to millions of simultaneous defaults, various models

emphasize the amplification of shocks caused by the forced sale of leveraged real estate (Shleifer and Vishny 1992, Kiyotaki and Moore 1997, Krishnamurthy 2003, 2009, and Lorenzoni 2008), as a systematic emergency sale of foreclosed real estate could lead to a further reduction in house prices, affecting real activity such as housing investment and consumer demand. Mian et al. (2015) find a strong correlation between state foreclosure laws and foreclosure propensity, which indicates that the judicial environment might be an instrument to reduce the negative externalities of forced sales. In this context, this thesis will provide new insights into how a unique foreclosure process impacted forced sales discounts.

Other theoretical models predicting a supply-induced price effect of foreclosures are often based on temporary market displacement where buyers of assets face limits in their ability to purchase the corresponding assets (Shleifer and Vishny 1992; Krishnamurthy 2003; Lorenzoni 2008). This represents a situation where real estate prices are driven down, hence reducing potential collateral value due to increased supply with decreased demand, this price dynamic will consequently reduce demand even more by driving down property values which did not foreclose by the usual economic effect of demand and supply, as reduced home prices reduce collateral values, wealth and consequently the ability of people to purchase additional property. This thesis will study the existence of foreclosure discounts as driving factor of this market dynamic in a unique sample of the Amsterdam residential real estate market from the 16th to 19th century with an uncommonly high degree of detail and a unique foreclosure process. In addition to that this thesis will investigate the time variation of this foreclosure discounts and will try to combine quantitative and qualitative methods to draw conclusions on the drivers of foreclosure discounts during the sample period. In a third step this thesis analyzes the occurrence of spillover effects, this analysis will deal with the unique sample features and confirm previous research.

While there are several streams of literature that discuss foreclosure discounts and spillover effects to the best of my knowledge there is no discussion of such effects in a historical setting, with foreclosure processes and macroeconomic conditions different from today. This thesis exploits a unique dataset of the city of Amsterdam to research the impact of foreclosures on residential real estate. The dataset is taken from Amsterdam City Archives and consists of 164,047 real estate transactions in Amsterdam and its surroundings from 1509 until 1811. Due to the historical setting, the data has an uncommonly high level of detail on the transaction level, which results in 84 variables across 164,047 transactions. This allows verifying quantitative hypothesis via a qualitative and quantitative analysis of micro-level data. This

thesis uses the microdata at multiple occasions to verify a hypothesis while restricting the analysis to a reasonable grade of detail due to the time constraints of a master thesis, this provides unique insights and might serve as a source for future research. In addition to that, Amsterdam applied a unique foreclosure process during the covered time period, which allows to compare the procedural efficiency when dealing with foreclosures today and during the sample period. We can see that the Anglo-Dutch premium auction significantly reduced negative externalities by having a 2-step procedure which defines upper and lower boundaries for the final bidding round (Boerner et al. 2012). This is unlike auction processes today, which generally only set lower boundaries and hence expose the bidder to larger uncertainties, such as characteristics like the exposure to potential additional claims on the property or the limited inspection right are similar in both procedures (Shneyerov et al. 2015). This enables us to investigate the process efficiency of an alternative procedure for foreclosures under different macroeconomic conditions and over the full real estate cycle. This thesis finds that the overall process efficiency was very high, which is in line with previous research (Harding et al. 2012) that states that in efficient markets foreclosure discounts seem counterintuitive but it also highlights the efficiency of the Anglo-Dutch premium auction process which confirms the research of Boerner et al. (2012).

Due to the long period which is covered time variation in foreclosure discounts can be identified. The high detail grade of the data and the long time period help to identify the drivers of time-varying foreclosure discounts. This thesis identifies time variance by a simply identifying foreclosure discounts in different time brackets, then it looks at the unique features of every time period. Given that institutions are constant throughout the full sample period, the features of the different time periods were used to develop a hypothesis about the drivers of foreclosure discounts, which is tested in a later step. The analysis of foreclosure discounts during and after times of crises is complemented by a qualitative analysis of individual investor behavior to strengthen the quantitative hypothesis. Overall this thesis contributes to existing literature by analyzing a detailed dataset in an integrated approach combining quantitative results with qualitative analysis. The results of this thesis do not only enhance our understanding of foreclosure effects and possible externalities of foreclosures on neighboring properties but provide new insights by covering multiple real estate cycles in a historic setting with unique procedures, while allowing for detailed conclusions due to the high data quality.

This study finds no significant foreclosure discounts over the full sample period, which indicates high efficiency when dealing with foreclosures in the unique setting of the sample period. This is in line with the argumentation of Harding et al. (2012) who argue that the existence of a foreclosure discount would represent an arbitrage opportunity. When analyzing time variation of foreclosure discounts I find significant foreclosure discounts in certain time periods, which is opposing the findings of Harding et al. (2012) but confirming the findings of Aroul and Hansz (2014), who find time-varying foreclosure discounts. While an analysis of drivers shows that foreclosure discounts decrease with increasing market price levels, no statistical significance can be found, the same applies to the number of foreclosures in the market. While the central drivers remain quantitively unclear, the results of this thesis confirm the findings of Harding et al. (2012) of no excess returns when acquiring property in a foreclosure sale and selling via normal procedures. The analysis reveals significant foreclosure discounts when a property was bought via normal procedures and sold via foreclosure sales in certain subperiods. This unique finding combined with an analysis of individual investor behavior leads to the hypothesis that foreclosure discounts might be driven by the quality of the real estate, which might not be driven by the fundamental quality but rather be a consequence of delayed maintenance as a consequence of the financial problems of homeowners preceding a foreclosure. This argumentation is in line with Clauretie and Daneshvary (2009) and Sumell (2009), who find that foreclosure discounts are higher in houses exhibiting less quality.

When analyzing spillover effects I find significant negative spillover effect of 0.3% from foreclosures to other properties in the same street. As the data allows to identify the location of properties on a street level, while having very long streets with over 600 properties in the sample, it is tested whether the street length influences the degree of the spillover effect. When analyzing the spillover effect in the 40 largest streets and in the rest of all streets, as a basic test which reflects the high skewness of properties per streets, I find a larger spillover effect [0.6%] in the smaller streets while spillover effects show a smaller economic magnitude [0.2%] and no statistical significance for the 40 largest streets. This is in line with previous findings of previous research which finds that spillover effects are a highly local phenomenon (Lin et al. 2009; Towe and Lawley 2013; Immergluck and Smith 2006; Harding et al. 2009; Munroe and Wilse-Samson 2013; Campbell et al. 2011). When quantifying this effect it can be seen that the spillover effects reduce per additional building in the street by 0.006%, hence the more buildings in the street, the smaller the spillover effects. As Li (2017) argued that spillover

effects are time variant, the same basic analysis of splitting the sample period into different sub-periods was applied in this thesis to identify potential time variation. The results of Li (2017) are confirmed insofar, that I find significant time variance in spillover effects. Furthermore, the spillover effects seem to be related to the general price development in the real estate market, as significant positive spillover effects co-occur with times of crisis in the residential property market.

A microdata level analysis reveals that many large investors in the real estate market refrained from purchasing properties in times of crisis and hence pulled out of the market, rather than buying foreclosed properties in large-scale. The same applies to people who are affected by large scale foreclosures, most people with large-scale foreclosures did not return to the real estate market despite being part of families with substantial wealth. Both groups are people which should be able to provide liquidity in a market which is distressed, as this is not happening a possible explanation for increasing foreclosure discounts and increasing spillover effects in times of crisis might be the structural change of the relationship between supply and demand. As the full sample period is characterized by a demand overhang due to the continuous population increase, the sudden removal of demand and creation of excess supply might have driven up foreclosure discounts and spillover effects, as an exact quantitative assessment is beyond the scope of that thesis this theory relies on descriptive statistics and is subject to further research.

The rest of the thesis is structured as follows: Chapter 2 will discuss the streams of literature which are affected by this thesis and develop the working hypothesis for this thesis. After that, chapter 3 will give an overview of the historical context and give an introduction to the procedural circumstances in the specific historic context. This is followed by chapter 4 which introduces the data used in this thesis and its unique characteristics. Chapter 5 will analyze foreclosure discounts over the full sample period via quantitative and qualitative methods, the finding will be extended in chapter 6 where the time variance of foreclosure discounts is investigated. To finish the analysis chapter 7 will investigate the presence and characteristics of spillover effects of foreclosures during the sample period. The chapters 5 to 7 all start with an explanation of the applied methodology and continue with the research results. In chapter 8 the results of the analysis part are contextualized and further discussed. The thesis will end with identifying the limitations of this thesis and the needs for further research before concluding this thesis.

2. Literature review

Several streams of literature are affected by this thesis. While it is related to the current discussion of foreclosure discounts, this thesis also adds new academic findings to the assessment of spillover effects of discounts of foreclosed properties on neighboring properties. Lastly, this research adds to the understanding of real estate markets in a historical context.

2.1. Foreclosure discounts

This thesis is related to theoretical literature investigating the impact of foreclosures on real estate prices. The stream of literature investigating foreclosure discounts in real estate markets is widely accepted and is based on multiple quantitative studies of housing data. Pennington-Cross (2004) finds a foreclosure discount of 22% using a repeat sales methodology on US-housing data from 1995-1999. For Cleveland, Sumell (2009) finds a foreclosure discount of up to 50% for single-family houses. Campbell et al. (2011) find an average foreclosure discount of 27% relative to the value of the house, using a hedonic regression in a dataset of 1.8 million transactions in Massachusetts. They explain this discount as a cost of protection against vandalism risks, as houses are unprotected as they are likely to not inhabited. Zhou et al. (2015) find that foreclosure discounts are negatively related to recent house-price appreciation and find that high foreclosure discounts for lower value properties are likely due to property conditions. Clauretie and Daneshvary (2009) report in a comprehensive analysis a conditional foreclosure discount of less than 10% in data for Clark County, Nevada, between 2004 and 2007. They use a hedonic regression controlling for various property and neighborhood characteristics such as time on the market, cash sales and property condition.

Hardin and Wolverton (1996) extended the research focusing not exclusively on residential real estate but including income creating investment properties, they confirm the existence of foreclosure discounts in a magnitude of 22%. They argue that investors might be willing to accept discounts due to atypical seller motivations such as satisfying regulatory capital requirements, mitigating negative stock price effects or protecting credit ratings.

While most literature researches housing prices in the United States Donner et al. (2016) use data on sold apartments and single family homes from 2006 to 2013 in Stockholm, Sweden, to check via a hedonic spatial Durbin model for foreclosure discounts. They find a foreclosure discount of 20.1% for foreclosed apartments and 24.6% for foreclosed single-family houses and find in addition to that, that foreclosure discounts increase when the number of transactions

is limited. The second European sample, which is based on a universe of adult Danes in the period between 1990 and 2010 used by Andersen and Nielsen (2017). They conduct a natural experiment that reveals, that foreclosure discounts are larger in when house prices contract. The authors argue that the magnitude of discounts is related to the urgency of a sale, defined by the current market conditions and the financial situation of the seller.

In general, there seems to be a consensus about the existence of the default discount in recent literature but the reason behind this discount is continuously debated, one line of reasoning is that foreclosed properties, on average, are of lower quality as distressed owners of homes are less likely to maintain the property. This is confirmed by Clauretie and Daneshvary (2009) and Sumell (2009), who find that foreclosed homes with lower quality rating exhibit larger-than-average foreclosure discounts. Opposed to that, Harding et al. (2012) argue that the existence of a foreclosure discount would represent arbitrage opportunities and would hence allow purchasers of REOs [Real estate owned] to generate positive excess returns. They test this hypothesis by comparing the holding returns of REO buyers with those of buyers of similar properties that are not in financial distress and do not find significant excess returns for investors in distressed properties. Hence, they argue that the market for REOs operates efficiently and hence no arbitrage opportunity can exist which would, in fact, be an argument against the systematic existence of a foreclosure discount. This view is supported by Carroll et al. (1997), who comment in their paper the results of Forgey et al. (1994) and argue that the inclusion of ZIP-code dummies and common characteristics between foreclosed properties and their neighboring properties, causes the findings of significant foreclosure discounts between 12.18% and 13.96% to diminish to insignificant values between 0.17% and 2.59%. Consequently, Carroll et al. (1997) argue finding a significant foreclosure discount is the consequence of omitted variables in the statistical assessment rather than the existence of an economically significant discount.

This view is opposed by Aroul and Hansz (2014) who hypothesize that foreclosure discounts are dependent on house price volatility. Therefore the authors analyze foreclosure discounts in a sample of Fresno, California from 2006 to 2010, which due to the housing crisis in 2008 incorporates significant house price volatility. They find a 20% discount for foreclosure transactions which remains consistent when controlling for the endogeneity of time-on-the-market and self-selection bias. The magnitude of foreclosure discounts was challenged by Clauretie and Daneshvary (2009), who argue that, under the assumption of efficiency in real

estate markets, foreclosure discounts of 20% seem counterintuitive. The authors argue that findings that confirm foreclosure discounts of that magnitude are caused by an upward bias induced by omitted variables, they name the physical condition of the property and the relationship between marketing time and price as examples for such omitted variables.

Zhou et al. (2015) argue that the high variability in identified foreclosure discounts arises due to a lack of common definition of a foreclosure discount and subsequently define a foreclosure discount as the discount of the real estate owned (REO) sale price relative to a normal-sale estimated market value. They apply this definition on a dataset of 1.34 million REO sale transactions across 16 core-based statistical area (CBSAs) between 2000 and 2012 and find a significant foreclosure discount. Next, to that, they state three other empirical noteworthy findings, they find that a concentration of foreclosure sales increases the foreclosure discount, that foreclosure discounts are negatively related to recent house price appreciations and that high foreclosure discounts are often associated by houses of lower quality.

Summarizing it can be said that there seems to be a consensus about the fact that foreclosing properties sell at lower prices than properties which are not sold via foreclosures while there is an ongoing debate about whether this represents an arbitrage opportunity and is hence a market inefficiency or whether the lower sales price is inherent in the different conditions of foreclosed properties. This thesis tries to incorporate structural quality difference effects in the methodology and hence focuses on the explanation of foreclosure discount via a market inefficiency which might be explained by procedural uncertainty (Chinloy et al. 2017). In this context I use the similarity of foreclosure processes, namely having no right to inspect the property that is auctioned, having a remaining risk of additional claims on the property which are not addressed by the process of the execution remission and the fact that borrowers which foreclose are likely to have experienced a significant period of financial distress before foreclosing and hence might have neglected required maintenance on the property. To hypothesize that I will find a significant foreclosure discount throughout the full sample period, despite the earlier described procedural advantages of the Dutch-Anglo premium auction (Boerner et al. 2012). I believe that the quality effect, which might be driven by the financial situation of the owner, by for example delaying required maintenance, in combination with the lack of an inspection right and the remaining risk of additional claims on the auctioned property are dominating the effect of the advantageous procedural design of Anglo-Dutch premium auctions. This assumption is partly driven by the uncertainty of the range given by the

auctioneer, as the upper range is non-binding it might not significantly reduce the uncertainty when it is chosen very high. In addition to this main hypothesis I hypothesize to see time variation in foreclosure discounts, as the full sample covers multiple real estate cycles and Zhou et al. (2015) find a negative relation of foreclosure discounts to price appreciation in real estate markets I expect to see increasing foreclosure discounts in the times of economic crisis which materialized in a residential real estate crisis, for example, the period after the beginning of the Anglo-Dutch war in 1784 and the connected negative impacts on the economy. I do expect this time variation to be significant, as Amsterdam experienced during the sample period a large increase of inhabitants, as described by van der Woude (1982), this means that there has been very high demand for properties during the times of economic prosperity which is covered in the sample. As housing supply is limited and can only be extended gradually over time, I assume that the demand-overhang caused in many cases that the access to housing, irrespective of the procedural form of purchasing the property, was outweighing the previously described uncertainty associated with foreclosure sales. While this might have been valid in times of economic prosperity and inhabitants growth, this can not be assumed in times of economic crisis, as this limits the amount of potential real estate buyers and hence reduces or even reverts the demand overhang. In these times procedural uncertainties connected to the foreclosure process increase, as worsening economic conditions, also increase the risk of additional claims on the property as people might try to overcome seemingly temporary financial difficulties arising for example after a loss of a job, with additional credits where the own real estate is used as collateral. As in times of crisis, the effect of a demand overhang reduces and the risks associated with foreclosure sales increase, I hypothesize to find intra-sample time variance of foreclosure discounts which might be associated with the overall price development of the real estate market, as this seems to be a reasonable indicator for the prevalent supply-and-demand relationship.

2.2. Spillover effects of foreclosure discounts

The assumption that in many cases a contagion effect of foreclosure discounts on nearby properties exists is researched in the second stream of literature which relates to this thesis. Here analyzing co-movements of Case-Shiller Home Price Indices for 14 metropolitan areas in the United States between 1992 and 2008 Kallberg et al. (2014) find that the co-movements, which are not attributable to the fundamental factors that determine real estate prices, are increasing over time. They argue that this increase can be explained mainly by the underlying

systematic real and financial factors and that this would be consistent with a greater fundamental integration of these markets. But the authors also argue that the existing excess co-movements are a less important factor for structural housing prices than commonly believed. Immergluck and Smith (2006) find in a dataset of more than 9,600 property transactions in Chicago in 1999 that foreclosures within an eighth of a mile of a single-family home result in a decline of 0.9% in value of the home which has not been foreclosed. In the same line of research Harding et al. (2009) find that evidence of a contagion discount of roughly 1% per nearby foreclosed property by simultaneously estimating the local price trend and the incremental price impact of nearby foreclosures. They also find a high local dependency, via strong decreases in contagions discounts, when the distance to the foreclosed property is increased.

Lin et al. (2009) find that spillover effects of a foreclosure on neighborhood property values depend on two factors: the discount of foreclosure sale and similarity of the property that was foreclosed to the property that is sold, as these factors drive the inclusion of a transaction in the valuation multiple. Their empirical analysis identified a radius of 0.9 kilometers [km] in which foreclosed properties cause contagion discounts while these discounts show a declining persistence over 5 years. In their sample, the most severe contagion discount is 8.7% discount, which gradually drops to anywhere between 1.7% to 4.7% over the time period of up to 5 years after the liquidation sale.

Arguing that most previous research on spillover effects of foreclosure discounts on non-distressed house sales are based on samples from stable housing market periods, Daneshvary et al. (2011) use transactions for 2008 from a housing market with a relatively large number of REO sales and foreclosures. They find that REOs and foreclosures have the same spillover effects and quantify this effect at 1%. Consequently, they analyzed that the total cumulative effect of distressed neighbors can cause a loss of value on a neighboring property of up to 8%. When distressed sales are excluded from this estimation the marginal spillover effect increases to 2% and the maximum cumulative effect in the sample increases to about 21%.

This is in line with the research of Li (2017), who finds a negative effect on property prices is significant from nearby foreclosures, real estate owned (REO) listings and REO sales, but not from default and delinquent properties. She also states that there is time-variation in terms of having a larger effect in depressed markets and a smaller effect in appreciating markets. The author argues that the most plausible explanation for the spillover effect is a depression of the

associated reference prices. By disentangling the effect of changed supply and dis-amenity stemming from deferred maintenance or vacancy of neighboring properties Hartley (2014) wants to isolate the cause for spillover effects in the neighborhood. The author finds that the effect of dis-amenity is close to zero while each extra unit of supply decreases prices within 0.05 miles by about 1.2%, which is in line with the magnitude of previously measured spillover effects. Extending the research to measuring not only the impact of a neighboring foreclosure and REO process but including the duration of such an impact Zhang et al. (2015) find a negative neighborhood effect, measured by the negative externalities resulting of neighboring foreclosure and REO processes when extending the length of the foreclosure process.

Towe and Lawley (2013) extend their research beyond quantifying the effect of foreclosures on neighboring property values and hypothesize that foreclosures have an impact on the foreclosure likelihood of neighboring property and this implies a negative social multiplier effect of foreclosures on neighborhoods. They do find that a neighbor foreclosure increased the likelihood of additional defaults within the neighborhood by 18%. This is in line with the findings of Munroe and Wilse-Samson (2013), who find that completed foreclosures cause between 0.5 and 0.7 additional filings within 0.1 miles and argue that learning plays an important role in contagion, rather than the pecuniary externality of the neighboring foreclosure, as the contagion effect is largely driven by borrowers which are not facing the immediate threat of default.

Analyzing the implications and dynamics in “hard-hit” neighborhoods in New York City and the core counties of Atlanta and Miami, Ellen et al. (2014) find that the most affected regions measured by the relative occurrence of REOs do not show characteristics of being the poorest or having the highest unemployment rates. They also do not find that investors do account for a significantly higher proportion of purchasers of REO properties in the hardest-hit neighborhoods than in other neighborhoods.

While there seems to be a general consensus on the fact that foreclosures do have an impact on their neighborhood, Calomiris et al. (2012) argue that the association, which can be observed between non-distressed house prices and foreclosures, is mostly driven by the endogenous adjustment of foreclosures to prices via the strategic choices of homeowners and lenders and not through the effects of foreclosures on home prices. The authors base this argument on a panel VAR, including macroeconomic and housing variables such as employment, permits or sales, using quarterly state-level data from 1981 until 2009. They find a dominating

relationship where prices have a much larger impact on foreclosures than vice versa. Summarizing the literature of spillover effects from foreclosures, recent literature finds that the spillover phenomenon is a highly local effect which decreases with increasing distance to the property, when it comes to explaining the spillover effect the main theories are that prices which are used for comparison are influenced by a property which foreclosed and possibly was sold at a discount or that a lack of maintenance on foreclosed properties damaged the neighboring properties by diminishing the appearance of the neighborhood (Harding et al. 2009) or that changes in supply cause the spillover effect (Hartley 2014). Another explanation is the inclusion of foreclosed properties when assessing the value of a nearby property, under the assumption that the foreclosed property transaction was processed at a discount (Lin et al. 2009). As little is known about value assessments of property in the 16th to 19th century in Amsterdam, but the conditions of deteriorating neighborhood appearances as a consequence of lack of incentivization and lack of financial resources to maintain the property and the effect of supply changes should be present in a historical setting, significant spillover effects are expected throughout the full sample period. This can be supported when foreclosure sales are seen as sales which involuntarily add supply to a market in an unideal moment market. Hence these transactions create market imbalances via creating excess supply, relative to the normal supply level which characterizes a respective period. That materializes in changed supply-and-demand relationships that consequently change the price for properties that are similar in terms of fundamental characteristics and location. Consequently, I expect strong time variance of these effects with an increase in spillover effects, when demand is limited by for example worsening economic conditions and changes in supply directly materialize changes in price and are not masked by excess demand, this hypothesis is in line with the argumentation of Li (2017).

3. Historical Background

This section will provide the general historical background of Amsterdam for the studied period and discuss the general structure of the housing market in Amsterdam and the procedural requirements for the acquisition of houses during the sample period. This description is complemented by an introduction into the legal proceedings following a default of creditors in the context of real estate credits. In addition to that, I will introduce the Anglo-Dutch premium auction as the auction mechanism of foreclosure sales and compare this mechanism with the currently prevalent form of foreclosure auctions.

3.1. Amsterdam in the 17th and 18th century

The studied period from 1509 until 1811 covers the rise of the Netherlands to European economic leadership, the Dutch Golden Age and the subsequent decline of the Dutch economy. During that time Amsterdam played a central role for the Dutch economy and became a global trade capital, but the time period also covers Amsterdam's decline of importance as trade capital, due to the emergence of competitors like London and the German North Sea ports. The book of de Vries and van der Woude (2007) describes the development of the Dutch economy from 1500 until 1815 and serves as the main source of information for the remainder of this section.

Amsterdam had an important role as a driver of the Dutch economy due to its role as European trade hub which hosted at its heights more than half of Europe's total merchant marine capacity (Blanning 2008). In the late 16th and 17th century Amsterdam accumulated rapidly trade capital from merchants outside of the Dutch Republic. High-risk ventures like revolutionary expeditions to the lands of South and Southeast Asia attracted those merchants and were soon incorporated into the Dutch East India Company (VOC). The success of the VOC can be seen in the enormous profits and the expansion of the fleet from 827 ships before 1610 to 3049 ships between 1650 and 1660 (Parthesius 2010), which not only illustrates the economic success of those ventures but also the importance of Amsterdam for the global trade activities. This economic success led to fast pace population growth and strong urbanization, defined as population increase in cities is higher than the population increase in rural areas. This materialized in an increase from 150 thousand inhabitants in urban areas in the region of Holland in 1550 to approximately 400 thousand inhabitants in urban areas in the same region in 1650 (van der Woude 1982). Given the aerial limitations in Amsterdam, several expansion projects were required (Abrahamse 2010) to satisfy the increased need for housing in Amsterdam. In the 1650s the boom period reached its zenith with an overall productivity, which was the highest in Europe at the time and has been reflected in the high wage level of the Netherlands during that period.

However, two mutually reinforcing economic trends ended the boom period in the Dutch Republic. The closure of major European markets as a consequence of the second Anglo-Dutch war, Dutch-Swedish War and the Franco-Dutch War and the associated protectionist measures which the European countries took, led to an end of the increases in trade volumes for the Dutch economy. In isolation, the effect of reduced trade volume growth would probably not

have been so severe, but at the same time the continuous trend of rising price levels had reversed from inflation to deflation. Due to the stickiness of nominal wages in economic downturns (Bernanke and Carey 1996) real wages continued to rise, despite the economic downturn. Both reinforcing trends led to a substantial economic downturn and stopped the fourth expansion of the city of Amsterdam (Abrahamse 2010).

Despite this severe economic downturn, the economy of Amsterdam managed to recover during the late 17th and early 18th century. Amsterdam remained a wealthy city and repositioned itself as a leading financial center, in close cooperation with London. During the 18th century the population of Amsterdam remained at a constant level and consequently, there have been little changes in the housing stock. The period of political neutrality which characterized the 18th century of the Netherlands came to an end in 1780 with the start of the fourth Anglo-Dutch war. This marked also the end of wealth for Amsterdam, which was taken over entirely by the French in 1795 (de Vries and van der Woude 2007).

3.2. The housing market and procedural requirements for property transactions in Amsterdam

The economic importance of Amsterdam during the sample period and the consequential rise of the population in Amsterdam indicate the important role of the housing market in Amsterdam. Korevaar (2018) used the same archival data that is used in this thesis to discuss the structure of the housing market in Amsterdam and analyzes four features of the housing market. The description of the housing market and the introduction to procedural requirements for acquiring real estate during the 16th and 17th are mainly based on his work, the work of (van Bochove et al. 2015) and is complemented by additional research in this area.

Every transaction of real estate had to ratified and registered in front of the aldermen of Amsterdam (*schepenen*). Auctions or alternative forms of transfer organizations were possible but did not exempt buyer and seller from the duty to register the transfer with the alderman to initiate the formal transfer of ownership. The registration of property transfers was a requirement all over the Dutch Republic and was administered at the municipality level. The oldest available register for Amsterdam stems from 1563 and the latest transaction was registered in 1811.

Regular property sales were recorded in an act of ordinary remission (*ordinaris kwijtschelding*) that followed a standard format, as shown in the transcribed example in appendix A, that is taken from Korevaar (2018), which describes a transaction of the famous painter Rembrandt

The text shows, that the sellers' name and the buyers' name are mentioned and that the buyer had to bring two guarantors for the transfer. In addition, it becomes apparent that buyer or seller that could not legally represent themselves, such as died homeowners, women and children, had to be represented by guardians, which were usually close family members. Furthermore, details about the purchased object are described in a way which should ensure the correct identification of the transferred object. This description included the property itself but also the location. This is important as homes were not numbered in during the sample period and the location was identified based on the street name, points of interest or the owners of houses nearby. Additionally, the data set reveals that house prices are only recorded from 1637 onwards and while it was common to have multiple sellers, it was less common to have multiple buyers, which could be explained by the fact that many transactions with multiple sellers name the heirs of the original owner.Next to regular sales (*ordinary remission*) there were additional forms of property transfers. When a homeowner defaulted on a loan, which were always full recourse loans in the Dutch Republic during the time of the sample period, the possessed property could be auctioned off by the creditors via the city of Amsterdam, the exact process is described in the following chapter.

As Amsterdam had a large market for private credit it was possible that creditors had claims on a property although the debtor sold the property off. This was generally limited to a time period of 1 year. In case an acquirer of a house wanted to ensure that no creditor had a remaining right on the property which was acquired, the seller and buyer had to possibility to transact the property via a *willig decreet* at the court of Holland (van Iterson 1939). During that process, the acquisition was made public three times in 14-day intervals, which allowed creditors to make a claim and settle the debt. After that procedure, the creditor had no rights anymore on the property and had to settle the credit with the debtor without the initial security. Korevaar (2018) notes that this process was often used when there was significant doubt about the fact whether all credits have been repaid by the seller, as he finds a close correlation between the number of *willig decreeten* and the number of foreclosure sales. A similar process existed for foreclosure sales, these transactions were named *onwillig decreeten* and followed the same process with the same underlying reasons, with having a foreclosed property being

transacted.Another possibility was the transfer of property via the orphan chamber (*weeskamer*), the orphan chamber had the legal authority to register all transactions with a relation to the property of orphans in the books of orphan guard auctions (*weesmeesterverkopingen*), hence these transactions were not registered with the aldermen.

3.3. Defaults and other market dynamics in the housing market of Amsterdam

When a homeowner defaulted on the payments agreed upon in the mortgage agreement in Amsterdam in the 16th and 17th century there were three legal ways in which the property was transferred which are similar to modern foreclosure sales. The most used form was the transfer via an execution remission (*executie kwijschelding*), in this process the bailiff of Amsterdam would seize the assets of the debtor for the creditor, here it was common that the debtor had a possibility to pay the debt and subsequently avoid the seizure of his assets. When the asset was seized by the bailiff the debtor could request a letter from the aldermen, granting the permission for the auctioning of the seized asset. This was usually done via public auctions organized by the city of Amsterdam. After the auction, the transfer of ownership was directly registered with the aldermen as an execution remission (*executie kwijschelding*). This form of defaults shows significant similarities to the organization of foreclosure sales today. Boerner et al. (2012) describe an the Anglo-Dutch auction process which represents the auction process used during the 18th and 18th century in Amsterdam. An Anglo-Dutch premium auction constituted of two possible rounds of bidding. In the first round, bidders bid against each other with ascending prices as in a standard English auction, the highest bidder of the first round would receive a pre-determined cash prize (premium), regardless of the outcome of the second round. In the second round, the auctioneer would set a high price and call out decreasing prices if somebody was willing to bid a price between the high price and the highest price of the first round that person would win the auctioned object, hence everybody could participate in the second round. If no bid was made in the second round the winner of the first round would win the object. The earliest auctions following that process are documented in 1529 and were used throughout the Dutch Republic in the 18th and 19th century to sell real estate and other goods. Today there are two main forms of foreclosures: judicial foreclosure, which requires the creditor to go to court and receive a judge's approval to foreclose a property and nonjudicial foreclosure, where the creditor may sell the property or repossesses it without a judge's approval (Enoch et al. 2014). When looking at the process of judicial foreclosures today, as described for the state of Florida by Shneyerov et al. (2015), one can see that when the borrower defaults the court grants

the lender, upon specific request of the lender, a right to foreclose a property. After that, the lender is allowed to auction the property off to the highest bidder, in general via English auctions. While the title is transferred to the highest bidder, certain liens and encumbrances may survive the foreclosure sale. It is the obligation of the bidder to find out about these liens and encumbrances, which creates a high level of uncertainty. This uncertainty is increased by the fact that no "open houses" will be held, hence the bidder does not have the right to inspect the property before engaging in the auction. Similarly to the Anglo-Dutch process, it is common that the lender makes a bid for the property, which can be seen as reserve price and sets a lower price boundary previous to the auction process.

When comparing both processes we can identify interesting similarities and differences, which might have implications on the efficiency of the full process. In both processes, the acquirer of the foreclosed property is exposed to the risk of a remaining claim on the property, which could only be remedied during the sample period via *onwillig decreeten* or *willig decreeten* at the court of Holland as described before. When looking at the auction process it becomes apparent that the uncertainty remains high in both procedures due to the limited inspection rights, but the design of the Anglo-Dutch auction seems to be beneficial in terms of uncertainty as it determines lower and upper boundaries before entering in the final bidding stage, while auctions today just set lower boundaries by the bid of the lender. This is confirmed by the empirical findings of Boerner et al. (2012), who find a positive empirical connection between greater uncertainty in the security's value and a greater likelihood of a second-stage bid, which exhibits the characteristics of having upper and lower value boundaries. The authors state that this particular auction design solved a complex market problem and led to efficient auction prices. In the context of foreclosure discounts, the unique process design during the sample period might have reduced procedural uncertainty and hence reduced one explanatory factor for structural foreclosure discounts.

Mian et al. (2015) describe that institutions and regulations of foreclosure processes have implications on the likelihood of foreclosing a property and hence have implications for the change of housing supply in the market. This might lead to changing market dynamics with changes in regulation and hence would have to be reflected in the econometric method. This concern is remedied by the fact that the institutions and processes remain constant within the full sample, despite having a time-variant share on total transactions.

4. Data

The initial dataset "*transportakten*" from the Amsterdam City Archives consisted of 164,047 real estate transactions in Amsterdam and its surroundings from 1509 until 1811. The dataset constituted of the transaction ID to identify the transaction, sub-transaction ID to distinguish between potential multiple buyers and sellers, property ID to identify the property which was transacted. Additionally, the data includes a series, which identified the legal transfer procedure, for example, obedient court orders or execution remission. The transactions are further described by the date of the transfer, the purchase price of the transaction, the full name of all involved buyers and sellers or their potential legal representatives, in case of legal representation the data provides the reason for the requirement of legal representation. The location of the transacted property is defined by the place of the location for example "Amsterdam", the street name of the real estate, the original street name, the name of the house, if applicable and the position of the property for example "over het Boshuis" (over the forest house). Additional variables identified the nature of the transacted good, the data distinguishes between for example between house, land, rear house, garden, warehouse, workshop and 18 more subcategories which help to understand the nature of the transacted property. In total the dataset has 84 variables across 164,047 transactions with 454,680 entries.

The dataset was transformed for the necessary analysis in this thesis. In order to clean the dataset, the following restrictions were given for each subsample. Every transaction was included once, when a transaction was recorded multiple time e.g. when multiple sellers sold one house only the first seller was included in the dataset. As a next step all transactions that did not take place in Amsterdam were excluded, here a very strict approach was applied, excluding every transaction that did not have "*Amsterdam*" as an entry for the variable "*Plaats*" (place), in order to avoid noise from different pricing dynamics outside of Amsterdam. As a fourth step, every transaction that did not include a house was excluded, this was done via using the dummy variable "*huis*" (house) as a filter, this limits the sample to residential real estate. As a next step houses that were transacted for a price of zero or where no price was given were excluded, as prices of zero should not represent a market-driven price building for a house with an intrinsic value that should be higher than zero in any case. Usually, prices of zero are given in the sample when the price cannot be seen in the record of the transaction. To control for double entries a control variable was created by combining the date of the transaction, the property ID and the "*bedraag*" (price). This variable was filtered for double

entries. As all previously described data adjustments were done using automated tools in excel, the resulting datasets were checked manually for double entries and merged into one dataset.

In a lengthy manual process, matches were built, these matches are based on the property ID and the corresponding date. Every time a property was transacted more than two times in the total dataset the multiple matched transactions were recorded to measure the change in price for every additional transaction. Additionally, a variable measuring the log price change between the first and second sale was created and a variable measuring the time difference between the first and the second transaction in years. To measure the impact of insolvencies on street level one variable was created, the variable is a count of insolvencies, defined as sales via execution remissions in the same street in the year, preceding the recorded transaction. The final transformed dataset consists of 62,797 residential transactions with prices and 316 variables, of which 230 were newly created, the summary statistics of the most important variables can be found in in appendix B. When calculating returns for the matches, while including multiple transactions of the same property by calculating the returns between each known transaction, one finds 39,893 returns based on the previously identified matches. When looking at the different price distributions, we can see that all kinds of transactions show a heavy right skewness (figure 1). Campbell et al. (2011) found in their research the same characteristic right skewness of foreclosure sales, which is prevalent in the dataset used in this thesis, with having most foreclosure sales between the value of 15 to 9,115 Gulden but having a very long tail with the largest foreclosure sale of 103,000 Gulden. In total the dataset consists of 5,330 sales via execution remission, which represents 8.49% of all transactions in the sample.

It can be seen that execution remissions are more concentrated in the extremes, as one can see that the share of transactions within the highest and lowest transaction value bracket is higher than the share of transactions within these value brackets of all other forms of transactions. When comparing the distribution of foreclosure sales and normal sales, one can see that foreclosure sales are much more concentrated in the low-value bracket than normal sales. That confirms previous findings that foreclosures concentrate on low-value properties (Li 2017), while this makes intuitive sense, as people who purchase residential real estate that is cheaper might often have lower income and fewer savings and hence are more exposed to changes in income and consequently the economic conditions. The higher concentration of foreclosure transactions in very high property value real estate's is puzzling. It might be explained through

the smaller amount of foreclosure sale transactions, and an unusual high amount of rare high-value property foreclosures. This seems unlikely though through the length of the total sample. Another reason might be the emergence of financial products and the financing of high-risk ventures via financial products, here a later example will show that members of very wealthy families engaged in high-risk business ventures and eventually defaulted after longer periods of financial struggle defaulted on a massive scale. This period specific phenomenon might explain this above-average concentration of foreclosure sales in high the value bracket.

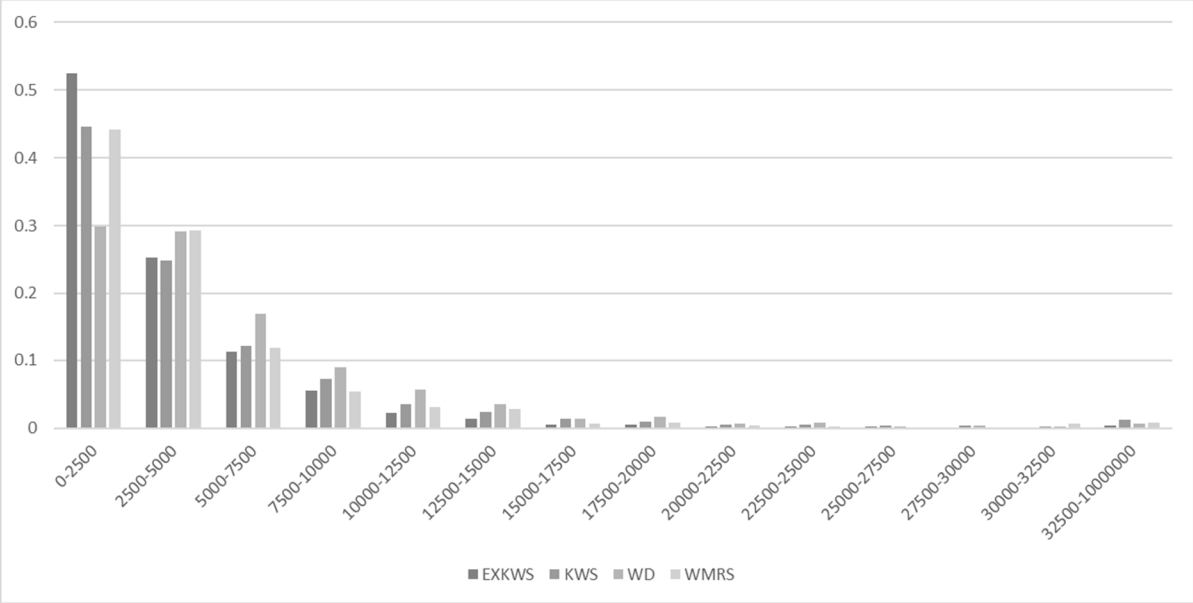

Figure 1: Overview over relative share of transactions per transaction procedure in different real estate value ranges

In terms of data quality one can see that the data until 1644 is very limited, often with less than 100 transactions per year but after 1644 the data quality improves significantly with an average number of 167 transactions and a maximum of 683 transactions in 1765. This might be driven by the share of registers that are preserved until today but seems relevant in terms of conclusions that can be drawn on data preceding 1644. Looking at the share of insolvencies per year one can see that the share of insolvencies increases when the share of transactions decreases (figure 2), this is driven by a decrease in absolute transactions combined with an increase of absolute foreclosures. Figure 2 and figure 3 also reflect the cycles in the real estate market of Amsterdam, from 1700 one can identify 2 major periods of crisis in the residential real estate market when looking at the share of insolvencies relative to yearly transactions. The first crisis after 1700 seems to occur around 1740, this co-occurs with a lengthy recession described by de Vries and van der Woude (2007). The second major real estate crisis can be seen after 1794 which was during the fourth Anglo-Dutch war and the connected detrimental

effects on European trade, which severely harmed the Dutch economy during that period. These crises are also reflected in the price development, when plotting median prices, to avoid the noises of averages, we can see that the real estate crises, that have been identified using the share of foreclosure sales on total sales, co-occur with the end of continued real estate price declines. In addition to that, we can see the tendency of foreclosure sales to be concentrated at the extremes of price ranges during a period due to the high standard deviation of median forced prices when comparing them to the median unforced prices (figure 3).

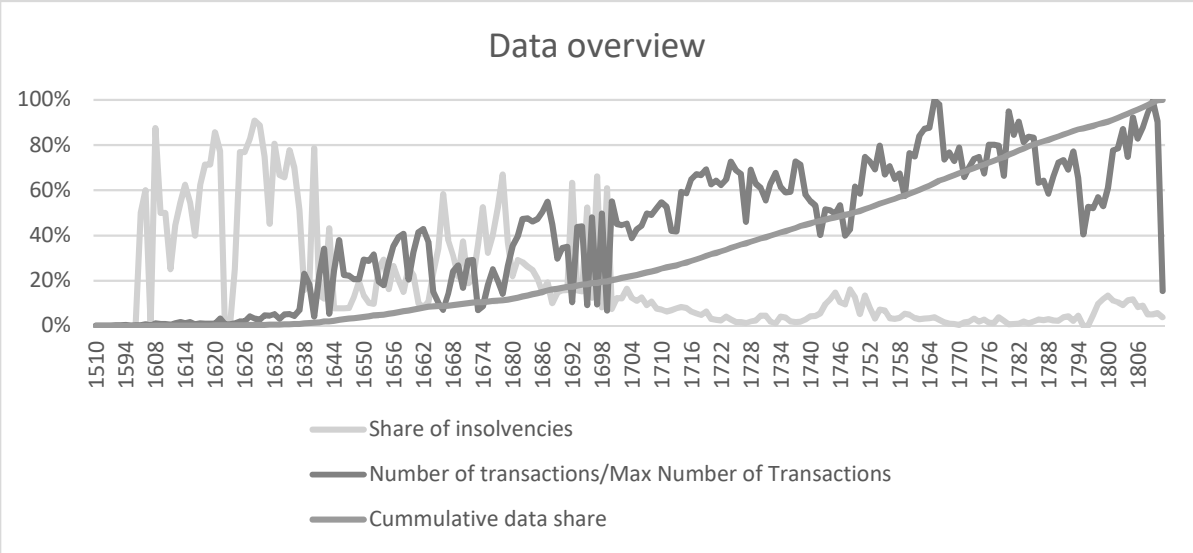

Figure 2: Overview transactions and insolvencies per year & data distribution over the sample period

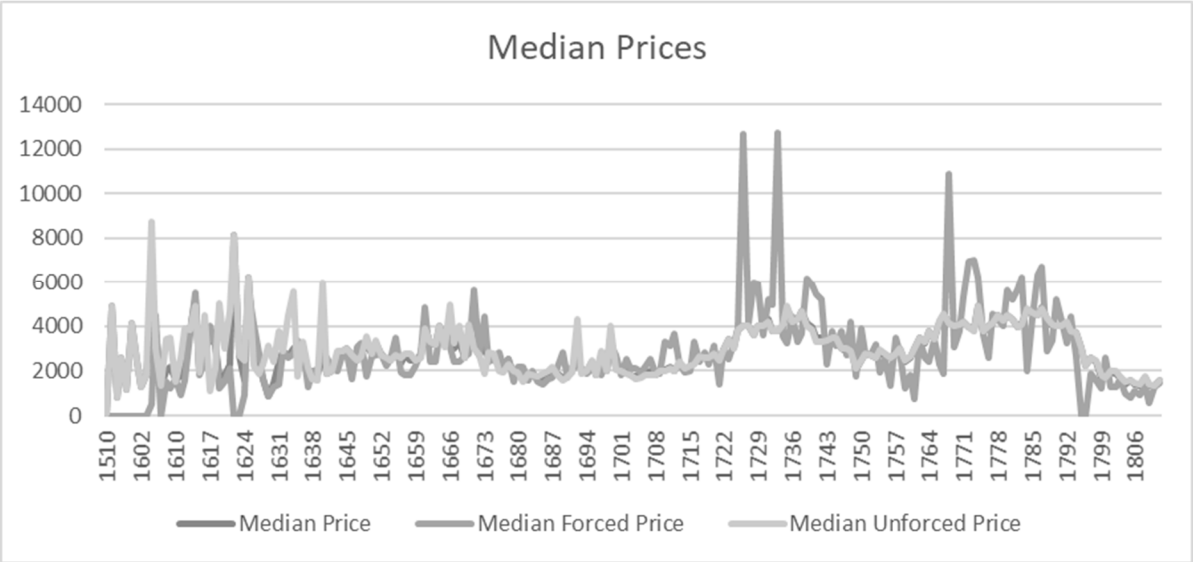

Figure 3: Annual median prices of total sales, forced sales and unforced sales

To analyze whether the different distribution of foreclosure sales might be procedurally induced by for example a monthly concentration of foreclosure auctions which would expose foreclosure sales to other monthly effects than regular sales, the distribution of monthly occurrence of foreclosure sales was plotted in figure 4. This distribution reveals that foreclosure auctions have not been taken place in specific months as no monthly concentration can be found in the data. Hence we cannot explain the higher standard deviation or the higher skewness of foreclosure prices via monthly effects or sales concentrations that might have affected the purchase behavior of real estate investors and homeowners.

When looking at further variables present in the dataset one can draw interesting conclusions on individual investor behavior during the sample period, which can be used to describe and explain the previously described characteristic of the real estate market and certain sub-dynamics within the residential real estate market especially in times before and after foreclosures or crises, for that purpose two samples were created.

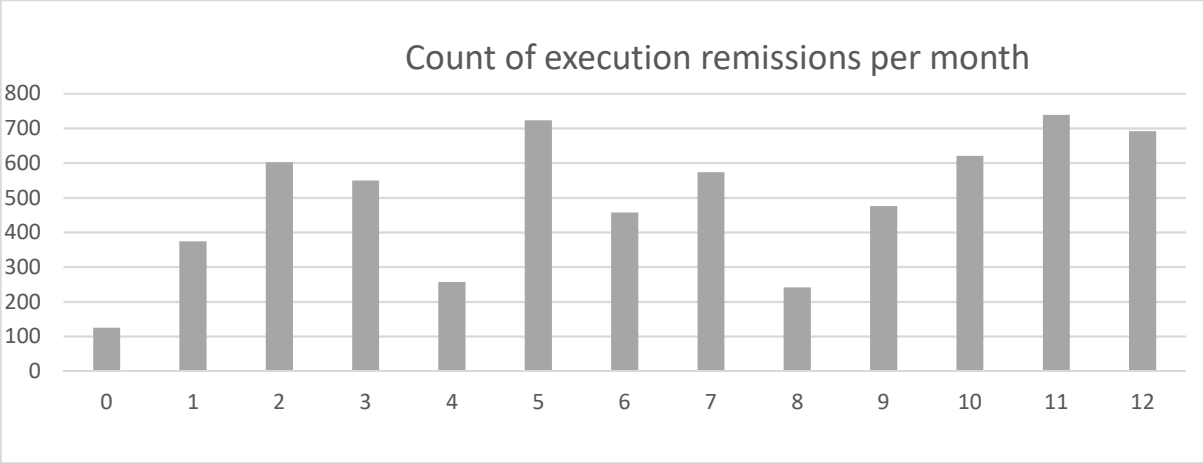

Figure 4: Monthly distribution of foreclosure sales over the full sample period

The first sample is a list of the 50 persons with the highest accumulated value of default transactions as a seller. The 50 largest sales from execution remissions accumulate to 1,915,462 Gulden, have an average transaction value of 38,309 and a median transaction value 34,100 which reconfirms the right skewness of execution remissions. At a later stage, this data will be used to gain a deeper understanding of what kind of people foreclosed large amounts, what they foreclosed and how the process affected their behavior in the overall market.

The second sample identifies a residential real estate market crisis from 1743 to 1751, this seems surprising as de Vries and van der Woude (2007) find that in 1742 the per capita GDP (Gross domestic product) was at was at the end of a long period of decline after the economic

peak of 1650 this means that the crisis, defined by the above average share of insolvencies on total transactions, co-occurs with an economic upswing. A period of ten years before and ten years after the crisis is defined and used to identify structural changes, like the average transaction price but also use the data to identify the most active people in the residential real estate market before and after the crisis and see how the behavior changed.

5. Non-time variant foreclosure discounts

5.1. Methodology

In order to identify foreclosure discounts in the samples an extended repeat-sales methodology is used, which is based on Bailey et al. (1963) and Case and Shiller (1987). This was done to reflect the nature of the dataset, that despite the sample size has little to no data which could be used in a hedonic regression opposed to the dataset that is used by Immergluck and Smith (2006). In addition to that Harding et al. (2009) argue that the repeat sales approach substantially reduced the omitted variable problem of hedonic models and is compatible to identify separate effects of the overall price trend.

The model is based on the standard repeat sales model and extends it by a term for the transaction type. It defines that a transaction price of a home *i* in a year *t* can be separated in the following characteristics:

$$P_{it} = A_i + T_i + M_t + e_{it} \quad (1)$$

A_i represents the quality of a home and is assumed to be time invariant. T_i represents dummies for the type of sale and M_t represents the monthly seasonality while e_{it} captures remaining transaction noise. Korevaar (2018) used additionally the term B_t to capture the current level of market prices via an interest rate parameter. Taking log differences, the return of a home *i* between time *t* and *s* can be written as follows:

$$p_{it} - p_{is} = \tau_{it} - \tau_{is} + m_t - m_s + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2) \quad (2)$$

The equation gets estimated for all pairs using OLS, where the time period in years, the type of sale and the transaction month are identified by dummy variables for each period, type or month. In order to reflect the nature of differencing, the dummy variables take the value one in period t and the value minus one in periods. Regular sales in January 1510 are taken as the

baseline for further estimations. Heteroskedasticity, which might arise through holding period differences, is controlled via the Case and Shiller (1987) adjustment, this is done for every regression that is based on a repeat sales approach in this thesis.

To address the concern that the combination of foreclosure sales drive foreclosure discounts, consequently that investors who buy houses from foreclosures to sell them via normal sales procedures and profit from that behavior, a set of dummies was created that controls for the different possibilities of including execution remissions in a transaction. While the standard model would identify two consecutive foreclosure sales as zero in the variable for foreclosure sales, I explicitly model this opportunity as a dummy which is one if both sales are foreclosure sales and zero if they are not, in the same way, the other two opportunities are modeled.

$$p_{it} - p_{is} = n_{is}fs_{it} + fs_{is\&it} + n_{it}fs_{is} + \dot{\tau}_{it} - \dot{\tau}_{is} + m_t - m_s + \varepsilon_{it} - \varepsilon_{is},$$

$$s < t,\ \varepsilon \sim N(0, \sigma^2) \qquad (3)$$

,where n_{is} represents a not forced sale, fs_{it} represents a forced sale and the combination from both [$n_{is}fs_{it}$ and $n_{it}fs_{is}$] represent in accordance to the time periods the different points in time and $\dot{\tau}$ represents the dummies for the remaining transaction forms. This leads to a clear identification of the impact of each possible combination on the price difference. From these combinations, I can draw conclusions on the quality of a home, by the realization of premiums or discounts in every possible combination. When I am able to realize structural premiums by acquiring foreclosed properties and selling them via normal sales procedures an explanation of the foreclosure effect by fundamentally worse quality is unlikely because when quality is discounted in a foreclosure process it should be discounted in a normal sales process, too. Hence no premium should be realized in this combination.

This procedure is supported by a microdata level analysis that covers the behavior of investors before and after the residential real estate market crisis from 1743 to 1751. Therefore investors were listed and ranked based on their transaction activity within 10 years after the end of the crisis in 1751. The behavior was analyzed analog to the analysis that was done for the people with the highest foreclosing values, for the 20 most active market participants measured by an absolute count of sales in the period after the crisis. This analysis offers interesting insights on whether the most active real estate investors used foreclosure sales to generate returns by

buying via foreclosure sales in the crisis and selling of the acquired assets after crisis via normal sales procedures to maximize profits.

5.2. Results

In table 1 one can see the results of the adjusted repeat sales regressions. Interestingly enough one can see that over the full sample period no significant foreclosure discount can be found.

Table 1: Regression results foreclosure discount

Formula	(2)	(2)	(2)	(3)	(3)	(3)	(3)	(3)
Variable	EXKWS	WD	WMRS	WD	WMRS	EXKWS_1 NORM_2	EXKWS BOTH	NORM_1_ EXKWS_2
Coefficient	-0.004713	0.010373	0.017998	0.010353	0.018285	-0.012231	0.000450	-0.012027
Std. Error	0.003264	0.006069	0.010355	0.006069	0.010361	0.005414	0.004054	0.013331
z-Statistic	-1.444059	1.709354	1.738013	1.705904	1.764836	-2.258987	0.111106	-0.902201
Prob.	0.1487	0.0874	0.0822	0.0880	0.0776	0.0239	0.9115	0.3669
Weighted Statistics								
Mean dependent var	-4.11E-07			-4.11E-07				
Sum squared resid	2,119			2,119				
Akaike info criterion	-0.105685			-0.105680				
Hannan-Quinn criter.	-0.090136			-0.089994				
Deviance statistic	0.051464			0.051462				
Pearson statistic	0.051464			0.051462				
S.D. dependent var	0.312756			0.312746				
Log likelihood	2,336			2,338				
Schwarz criterion	-0.056567			-0.056131				
Deviance	2,041			2,041				
Pearson SSR	2,041			2,041				
Dispersion	0.051464			0.051462				
Unweighted Statistics								
Mean dependent var	-0.014261			-0.014261				
S.D. dependent var	0.297361			0.297361				

Formula 2: $p_{it} - p_{is} = \tau_{it} - \tau_{is} + m_t - m_s + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2)$, with EXKWS being the transaction type dummy for foreclosure sales, WD being the transaction type dummy for *willige decreeten* and WMRS being the dummy for orphan sales. Not reported here are all yearly and monthly dummies, as they are control variables. Formula 3: $p_{it} - p_{is} = n_{is} fs_{it} + fs_{is\&it} + n_{it} fs_{is} + \dot{t}_{it} - \dot{t}_{is} + m_t - m_s + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2)$, with EXKWS_1 NORM_2 being the dummy for houses that were purchased via foreclosure sales and sold via normal sales, EXKWS BOTH being the dummy for houses that were bought and sold via foreclosure sales and NORM_1 EXKWS_2 Being the dummy for houses that were bought via normal sales procedures and sold via foreclosure sales. Not reported here are all yearly and monthly dummies, as they are control variables. Both regression results present the result after the Case and Shiller (1987) adjustment for heteroskedasticity.

This implies high market efficiency in the real estate market of Amsterdam during that time period. The overall results are in line with Harding et al. (2012) who state that the existence of a structural foreclosure discount would represent an arbitrage opportunity. This also confirms the findings of Boerner et al. (2012) who find that the Anglo-Dutch premium auction solves a

complex market problem. This means that the residential real estate market was, contrary to my initial hypothesis, very efficient and apparently exhibited a higher degree of efficiency than many real estate markets nowadays.

Looking at the findings of previous literature one central characteristic of the residential real estate market in Amsterdam during the sample period might influence the magnitude of the foreclosure discount. During the sample period, the city of Amsterdam experienced strong population growth induced by the economic success of the Dutch Republic and Amsterdam in particular (van der Woude 1982). This means that the city had to find housing to cater the needs of a strongly increasing population, which induced an increase in the level of demand and due to the inelasticity of supply Amsterdam should experience an overall price appreciation over large parts of the sample period. When this characteristic is combined with the findings of Zhou et al. (2015), who find a negative correlation between the magnitude of foreclosure discounts and real estate price appreciation, the lack of significance of the foreclosure discount throughout the full sample period makes intuitive sense. As a discount of 0.4% can be found but is not statistically significant I investigate at a later point the time variance of foreclosure discounts. A secondary finding of the first equation is the significant premium paid for *willige decreeten* over the full sample period should reflect decreased risks. When comparing the transaction of *willige decreeten* with the regular transactions, where housing purchasers were exposed to the remaining risk of residual claims from previous creditors, one can intuitively see why transactions via *willige decreeten* exhibit less exposure to risk than normal transactions and hence should realize a premium.

While the small, statistical insignificant foreclosure discount, makes intuitive sense given the characteristics of the sample period and the corresponding procedures, the question about the drivers of such foreclosure discounts remains open. Analyzing the argument that foreclosure discounts are driven by the underlying quality of the transacted property, the impact of different sales procedure combination on the change in price was controlled.

The results show that properties that are transacted first via foreclosure sales and then via normal sales are realizing 1.2% lower returns than other combinations, with all other combinations not yielding statistically significant results. This is in line with previous findings which find that foreclosure discounts are negatively correlated to the underlying properties quality (Zhou et al. 2015), as houses which were bought via foreclosure and sold via a normal

procedures generate lower returns than houses that were bought via normal procedures and sold via normal procedures, the sales price has to be lower as the previous analysis did not identify a consistent foreclosure discount. Hence the lower return is caused by a structurally lower sales price in the normal procedure which ceteris paribus implies a lower quality of the underlying transacted property.

To confirm this hypothesis a second analysis was done on the micro level of the existing dataset, the assumption was, when foreclosed properties are characterized by lower quality professional real estate investors, identified by the number of real estate transactions, should refrain from acquiring significant holdings in foreclosed real estate. Because they would know that the lower quality is reflected by offering a significant discount and following normal sales will discount the quality too, unless the lack of maintenance is resolved, which is going to require additional investments. The counter-hypothesis is when there is no quality difference investors should buy foreclosed properties to generate a risk-free profit. In order to verify this assumption a period of crisis was chosen, where a foreclosure discount has been identified in the previous analysis.

Microdata level analysis – investor behavior during and after the real estate crisis from 1743 to 1751

Most investors that sold significant amounts of real estate properties in the first 10 years after 1751 bought most properties before the crisis and left the real estate market for the duration of the crisis. An example of that is Jan van Gelder. Jan van Gelder was a shopkeeper who transacted in total 31 properties, he bought only 6 properties during the crisis and after the crisis, he bought 10 properties while selling 13 properties. Cors Schouten was another significant real estate investor who bought 18 properties, only 2 of them were bought via insolvency sales. His brother, Claas Schouten bought 13 properties, most of which were bought via normal sales procedures in the crisis. The same pattern continues, big real estate investors seem to have refrained as far as possible from buying properties from foreclosure transactions. This is a strong indicator for a quality difference between foreclosed properties and regular sale properties, this might arise due to the preceding time of financial difficulties which owner of houses in a foreclosing process face which would be in line with the argumentation of Zhou et al. (2015). While this could also be the result of very little market liquidity and low willingness to engage in transactions, I believe the fact that real estate investors, which are on the one hand heavily negative affected by the crisis in the real estate market, but on the other hand are very

wealthy do barely engage into real estate transactions might be explainable by the low willingness to engage in transaction. I think that the pattern that the same investors engage in normal transactions, while having the choice to engage in other foreclosure transactions is a clear indicator for a structural quality difference. This argument is strengthened by the fact that homeowners are often not willing to sell their properties at a loss (Genesove and Mayer 2001) and hence the access to houses that are sold via normal transactions, should be assumed to be more difficult than the access of forced sales in times of real estate market crisis. When this aspect is assumed to be true, the individual investor behavior is another argument for the lower than average quality of foreclosed properties. It should be mentioned that this quality difference is most likely a function of missing maintenance and other factors that are used to keep the quality level of a property as fundamental quality criteria such as the location, the size and kind of property are addressed in the repeat sales methodology. This also makes intuitive sense as a residential real estate foreclosure is usually the last resort after a long period of financial distress, in this time the average property owner is assumed to reduce costs as far as possible to avoid a default. A possible way to reduce costs is to delay required maintenance on the property, which would result in a deteriorating quality of the property which is not captured by the traditional repeat-sales method.

To summarize the findings the residential real estate market in Amsterdam has been very efficient over the full sample period which is in line with the argumentation that the high foreclosure discounts found in previous literature of about 20% (Pennington-Cross 2004; Campbell et al. 2011; Clauretie and Daneshvary 2009) are most likely caused by omitted variable biases as argued by Clauretie and Daneshvary (2009) and Carroll et al. (1997), who both argue that that high foreclosure discounts, are counterintuitive under the assumption of efficient markets as significant foreclosure discounts would represent an arbitrage opportunity.

That no such arbitrage opportunity exists is not only argued by Harding et al. (2012) but can also be seen in the individual investor behavior, where the largest real estate investors do not make use of the existing foreclosure discounts, which is most probably to be explained by below average quality of foreclosed homes (Clauretie and Daneshvary 2009; Sumell 2009), that is also reflected in the significant negative coefficient of the combination foreclosure sale with subsequent normal sale. Here I hypothesize that the quality difference results of a lack of maintenance as this deteriorating quality effect is not captured by the quantitative methodology

and makes intuitive sense when respecting the financial situation of debtors preceding a residential real estate foreclosure.

6. Time-variant foreclosure discounts

In order to verify the assumption of efficient residential real estate markets during the sample period, when measuring efficiency by the magnitude of the foreclosure discount I analyze the time variation of potential foreclosure discounts. That might arise because foreclosure discounts might be affected by the rising prices (figure 3; Zhou et al. 2015) during the strong inhabitant increase in Amsterdam (van der Woude 1982). While this strong inhabitant increase might dominate the effect over the full sample period, multiple residential real estate crises with falling prices were identified, which might have caused rising foreclosure discounts and consequently time variation.

6.1. Methodology

Time variation of foreclosure discounts is tested via the inclusion of multiple interaction variables that replace the term for execution remissions in the formula. The formula changes to:

$$p_{it} - p_{is} = fs_{it} * t_t - fs_{is} * t_s + \dot{\tau}_{it} - \dot{\tau}_{is} + m_t - m_s + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2) \quad (4)$$

,with t_t being a dummy for 5 defined time periods and $\dot{\tau}_t$ being the dummy for the remaining forms of transactions. The dummy is build-up like in a classic repeat sales design and interacts with a dummy that is one when the respective transaction occurred within the defined timeframe. This allows identifying foreclosure discounts in the chosen time periods while preserving the data quality and hence the statistical significance. To identify time variance in general, I started in 1601 and distributed the time intervals in 50-year steps, with the last step being a bit shorter. I use this very basic time intervals to develop an idea about the drivers of foreclosure discounts by comparing the results of the regression with descriptive statistics of the respective time intervals.

As this initial regression will deliver some puzzling results, which might be explained by the strong skewness of the foreclosure transactions in the sample (figure 1) and the behavior of individuals with very large foreclosures, a list of the 50 people with the highest values of cumulative foreclosure sales was created based on the microdata of the sample. The list was

checked for famous investors and personalities and subsequently, for all persons listed in this sample, a transaction history was created. This transaction history was checked for patterns with respect to purchasing behavior before the foreclosure, average transaction size, amount of foreclosed properties relative to owned properties and the activity in the real estate market after the foreclosures. This was done to analyze how people who were significantly impacted by foreclosure sales behaved subsequently in the market.

In a second step I use the insights gained from the previous analysis to analyze the drivers of foreclosure discounts in the sample period, as the foreclosure process remains constant I rule out an impact of changing institutions, the same is assumed for fundamental qualitative differences as these are controlled for in the same way throughout the full sample period. Consequently, possible time-variation has to be market driven, either in a direct supply and demand relation or in an indirect form, where changes in supply and demand relations, increase the importance of other decisive factors, such as the maintenance status of the property. To generalize I hypothesize that two factors drive foreclosure discounts, the general state of the housing market, measured by price as the best indicator for the current demand-supply relationship and the amount of foreclosures relative to total properties, as Korevaar (2018) finds that the 17th century had a very active mortgage market, hence there are relatively more foreclosures during that period, which might impact the foreclosure discount by significant supply and demand imbalances.

To incorporate these two explanatory terms, two interaction terms are added in the repeat sales formula (2), that results in:

$$p_{it} - p_{is} = b_t - b_s + fs_{it} - fs_{is} + \dot{\tau}_{it} - \dot{\tau}_{is} + (b_t * fs_{it}) - (b_s * fs_{is}) + (fs_{it} * exto_t) - (fs_{is} * exto_s) + m_t - m_s + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2) \quad (5)$$

,with *b* reflecting the state of the market in the year t and s respectively defined as standardized median price with the respective year, fs being a traditional repeat sales variable for execution remissions at the time t and s, $\dot{\tau}$ being a set of dummy variables for all other forms of transactions and *exto* being a measure of execution remissions per year divided by the number of unique properties in the sample at times t and s interacted with the dummy for foreclosure sales fs. In addition to that, the variable for the state of the market *b* interacts with the dummy for foreclosure sales. All variables described above are differenced according to their states at time t and s to reflect the repeat sales procedure. This formula allows isolating the impact of

changes in market price levels and changes in the relative share of foreclosures on the foreclosure discounts.

6.2. Results

The analysis reveals significant time variation of foreclosure discounts across the sample period. This is in line with the findings of (Li 2017), who states that the magnitude of foreclosure discounts is smaller in times of price appreciation, which is tested for this sample in a second step.

This analysis identifies significant foreclosure-related price impacts for three periods, from 1701 until 1750 a significant premium of 1.5% over normal transaction was paid for properties, from 1751 until 1800 a significant foreclosure discount of 2.8% can be found and from 1800 until 1811 the foreclosure discount increased to 3.5%.

Table 2: Regression results foreclosure discount

Formula	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Variable	EXKWS 1601_1650	EXKWS 1651_1700	EXKWS 1701_1750	EXKWS 1801_1800	EXKWS 1801_1811	WD	WMRS
Coefficient	-0.017781	0.007486	0.014634	-0.027756	-0.035156	0.013612	0.016228
Std. Error	0.013140	0.005459	0.006296	0.006940	0.009509	0.006146	0.010820
z-Statistic	-1.353178	1.371311	2.324357	-3.999212	-3.69715	2.214857	1.499805
Prob.	0.1760	0.1703	0.0201	0.0001	0.0002	0.0268	0.1337
Weighted Statistics							
Mean dependent var	-4.11E-07						
Sum squared resid	2,117						
Akaike info criterion	-0.106414						
Hannan-Quinn criter.	-0.090592						
Deviance statistic	0.051426						
Pearson statistic	0.051426						
S.D. dependent var	0.312700						
Log likelihood	2,355						
Schwarz criterion	-0.056434						
Deviance	2,040						
Pearson SSR	2,040						
Dispersion	0.051426						
Unweighted Statistics							
Mean dependent var	-0.014261						
S.D. dependent var	0.297361						

Formula 4: $p_{it} - p_{is} = fs_{it} * t_t - fs_{is} * t_s + \dot{t}_{it} - \dot{t}_{is} + m_t - m_s + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2)$, with EXKWS_1601_1650 representing the standard repeat sales coefficient for foreclosure sales (in the formula represented as fs_{it}) in the time frame from 1601 till 1650. EXKWS_1651_1700 representing the standard repeat sales coefficient for foreclosure sales (in the formula represented as fs_{it} and $-fs_{is}$ respectively) in the time frame from 1651till 1700. This is continued for the additional EXKWS dummies. In addition, I report the results for the other forms of transaction procedures as described before. Not reported here are all yearly and monthly dummies, as they are control variables. The regression results present the result after the Case and Shiller (1987) adjustment for heteroskedasticity.

1701 until 1750

The approximate premium of 1.5% for houses sold via foreclosure sales seems puzzling as it is contrary to all previously found literature. In order to understand this premium, the data was analyzed at its micro level, when doing that one can see that the sample period shows a constant decrease in share of foreclosure sales relative to other sales until 1740 at the end of a lasting deflationary period, the number of foreclosures, the relative share of foreclosure transactions on total transactions increased sharply while the number of total transactions decreased. The timing of this residential real estate "crisis" is puzzling as de Vries and van der Woude (2007) identified 1742 as the turning point of the Dutch economy, where it turned from a decrease into slight growth de Vries and van der Woude (2007) calculated for the Dutch economy in 1742 a gross national product (GNP) between 265 and 280 million guilders, or 135–142 guilders GNP per capita, which grows according to their calculations to 307 million guilders, or 162 guilders per capita in the decade of 1800 to 1810.

Microdata level analysis – major foreclosures and the example of Theodorus Fries

Checking the individual years, one can see that some years are despite a low amount of foreclosure sales characterized by very large sums which are paid for houses in foreclosure sales, for example on the 11. June of 1745 the house and brewery of Theodorus Fries were auctioned off for 103,000 Gulden. In the same year, a property on the Herengracht was foreclosed for 78,000 Gulden. These two transactions represent the largest transactions via foreclosure sales in the full sample. This pattern is repeated over other years of the emerging crisis, a possible explanation is that some rich family members used the emergence of financial instruments to leverage their ventures and utilize the upswing of the economy. This might have gone wrong in multiple cases which leads to foreclosure of very expensive properties which might now face the same foreclosure dynamics as the "average" property. The underlying explanation is confirmed when looking into the behavior of Theodorus Fries in the real estate market and his history. Theodorus Fries, who was married to Cornelia de Clercq had gone bankrupt for the first time in 1727, as a merchant in the Baltic Sea, with a debt of over 274,000 guilders. He settled with his creditors by repaying 10% of the total outstanding sum (Stichting Familiearchief de Clercq 2018). After that he bought in 1731 the brewery De Hooiberg, using debt financing with an annual amount of 5,000 guilders to be paid for the next 5 years and after that larger amounts at his discretion. To refinance his debt he borrowed from additional parties, including his own family, 30,000 guilders. From 1736 he continually had to borrow additional

money to keep up with his financial obligations. In 1745 he went bankrupt again with creditors claiming more than 225,000 guilders (Stichting Familiearchief de Clercq 2018; van Eeghen 1958). The large foreclosure sale in the sample is part of this second bankruptcy. This example shows how well-established families were able to accumulate significant debt financing to pursue their ventures and how these materialized in some cases. When excluding the largest 5% of foreclosures, in terms of transaction value, in a robustness check the premium loses its significance (not reported here).

1751 until 1800

The period covered in this coefficient represents a time of economic expansion in the Dutch economy, this materializes by a low relative share of foreclosure transactions ranging in between 0% and 4% per year in the times excluding the crises at the beginning as described above and at the end of the time period (figure 2). The previously described economic expansion starting in 1742 and ending 1780 is reflected by these low shares of foreclosure sales. The start of the fourth Anglo-Dutch war in 1780 resulted into trade decreasing rapidly and challenging the Dutch economy another time, with the proclamation of the Batavian Republic in 1795 (Schama 2005) and the resulting transfer payments to France made the state unable to intervene with reforms. This resulted in a wide economic crisis which continued through the French annexation (1810) and the proclamation of the United Kingdom of the Netherlands (1815), until 1850. The result of the war and the economic crisis are reflected in the data on the residential real estate market, from 1780 one can see a continued rise of foreclosure sales resulting in a 13% share of foreclosure sales on all sales in 1800.

The significant foreclosure discount of 2.8% is in line with the results of previous research and confirms the remarks of Li (2017) because, while we experienced in the previous time periods of the sample flat or rising residential real estate prices, this period shows an overall decrease of residential real estate prices over the full time-period (figure 3), hence the expected increase of foreclosure discounts due to market price depreciation materializes.

1801 until 1811

The foreclosure discount of 3.5% represents an increase of the foreclosure discount which co-occurs with worsening economic conditions. Residential real estate prices continued to fall during the period (figure 3), interestingly this does not decrease the sales activity in the market as the year 1809 is the year with most transactions recorded. In general, this result seems to be in line with the argumentation of Andersen and Nielsen (2017), who argue that the financial

situation and the current market developments are driving the magnitude of foreclosure discounts. As it can be reasonably assumed that the financial conditions of foreclosure sellers are worsening in times of economic distress and market conditions were deteriorating too, what can be seen in the drastically falling median price of residential properties in Amsterdam (figure 3), the rise of foreclosure discounts in times of economic and residential real estate crises seems intuitive.

To summarize the results of the check for time variation, it can be said that during the sample period there has been time variation of foreclosure discounts which is in line with previous literature (Aroul and Hansz 2014; Li 2017; Zhou et al. 2015). The foreclosure discounts seem to be driven by general real estate price behavior as the extent of significance and absolute magnitude increases in times of residential real estate crisis, with depreciating residential real estate values. The magnitude of foreclosure discounts is in line with the research of Clauretie and Daneshvary (2009), who oppose prior research and state that foreclosure discounts of 20% are caused by omitted variable induced upward biases.
The time variation and the magnitude of the foreclosure discount enable interesting conclusions, first: the residential real estate market in Amsterdam during the golden ages and their subsequent decline seem to not have been less efficient than the real estate markets today, due to the wide range of foreclosure discounts (Zhou et al. 2015), but as the magnitude is close to the lower band of estimations assuming at least an equal degree of efficiency seems reasonable. The time variation might also explain the different findings in prior literature, as time variation in relatively efficient markets imposes a significant sample selection bias risk which might explain in part the previous variability in estimates.

In order to explain the identified time variation, I analyze the impact of the general state of the housing market, measured by price as the best indicator for the current demand and supply relationships and the number of foreclosures relative to total properties. The results of this regression are highly insignificant and while the interaction variable which shows the effect of changes of the general price level makes sense, as it shows that the foreclosure discount decreases with increasing property prices, it is statistically highly insignificant. Despite the statistical insignificance the coefficient seems to be in line with the findings of previous literature (Li 2017).

Table 3: Regression results foreclosure discount

Formula	(5)	(5)	(5)	(5)	(5)	(5)
Variable	EXKWS	WD	WMRS	EXKWS_X_EXTO	EXKWS_X_STAN_PLEVEL	STAN_PLEVEL
Coefficient	-0.012609	0.010103	0.015585	3.595049	0.000194	0.014653
Std. Error	0.007523	0.006076	0.010368	4.453561	0.00505	0.001778
z-Statistic	-1.675996	1.66284	1.503248	0.80723	0.038509	8.239016
Prob.	0.0937	0.0963	0.1328	0.4195	0.9693	0
Weighted Statistics						
Mean dependent var	-4.12E-07					
Sum squared resid	2,116					
Akaike info criterion	-0.107302					
Hannan-Quinn criter.	-0.091548					
Deviance statistic	0.051366					
Pearson statistic	0.051366					
S.D. dependent var	0.312884					
Log likelihood	2,371					
Schwarz criterion	-0.057537					
Deviance	2,037					
Pearson SSR	2,037					
Dispersion	0.051366					
Unweighted Statistics						
Mean dependent var	-0.014261					
S.D. dependent var	0.297361					

Formula 5: $p_{it} - p_{is} = b_t - b_s + fs_{it} - fs_{is} + \dot{\tau}_{it} - \dot{\tau}_{is} + (b_t * fs_{it}) - (b_s * fs_{is}) + (fs_{it} * exto_t) - (fs_{is} * exto_s) + m_t - m_s + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2)$, with EXKWS representing the standard repeat sales coefficient for foreclosure sales (in the formula represented as $fs_{it} - fs_{is}$) In addition I report the results for the other forms of transaction procedures as described before. STAN_PLEVEL represents the standardized market price level (measured as standardized median price over the full sample period) in the respective year (in the formula represented as $b_t - b_s$). This term is interacted with the standard repeat sales term for foreclosure transactions, to assess the impact of the standardized market price level on the foreclosure discount. The second interaction term interacts the standard repeat sales term for foreclosure transactions with the share of foreclosure transactions on total sample properties (in the formula represented as $exto_t$ and $-exto_s$ respectively). Not reported here are all yearly and monthly dummies, as they are control variables. The regression results present are the result after the Case and Shiller (1987) adjustment for heteroskedasticity.

The high statistical insignificance of the relation between foreclosure discounts and the share of foreclosures relative to total properties makes the high coefficient of the interaction variable of foreclosure sales and the share of foreclosures impossible to interpret. All things considered the results of this very basic analysis are not significant and hence cannot be reliably used for an interpretation, this might be driven by the very basic definition of both added variables or the lack of significance on the price of foreclosure sales in general when assessing the

foreclosure discount over the full sample period. Due to the time limitation of this master thesis, the explanation of the identified time variation remains subject to further research and might help to significantly enhance the understanding of the dynamics of foreclosure discounts.

While the overall market seems to be efficient, the found time variation can partly be explained by the skewness of foreclosures which led in part to a foreclosure premium from 1701 till 1750, but also by the price behavior of the overall market, as Aroul and Hansz (2014) argue that foreclosure discounts depend on the price volatility of the overall residential real estate markets. This is also supported by the argument of Zhou et al. (2015), who argue that foreclosure discounts are negatively related to housing price appreciations. This makes sense not only when looking at the house price appreciation and the occurrence of significant foreclosure discounts, but is confirmed when looking at the historical context. Significant foreclosure discounts co-occur with crises in the economy, which are reflected in falling housing prices. As the beginning of the sample period is characterized by a large population increase (van der Woude 1982) and hence rising prices for residential real estate, due to the higher demand elasticity relative to the supply elasticity in residential real estate. Insignificant foreclosure discounts follow from the arising demand overhang, that implies that the utility of additional available housing exceeds the disutility of the lower than average housing quality, which might be caused by a lack of maintenance. In the times of the economic decline of the Netherlands, which defines the second part of the sample period, the demand as limited as only very wealthy people can acquire real estate when unemployment rises as a consequence of lower economic output. This limited demand might be the reason for rising inefficiencies in the market which materialize in rising foreclosure discounts.

7. Spillover effects of foreclosure discounts

As I identified significant foreclosure discounts in certain subperiods, I want to investigate the presence of spillover effects of these foreclosures on neighboring properties. As spillover effects are of major importance in the transmission of real estate market crises to the real economy. This reflects the central concern about foreclosure discount and major reason for governmental intervention in real estate crises, due to the negative externalities of decreasing house prices on the economies real activity, such as residential investment and consumer demand (Kiyotaki and Moore 1997; Krishnamurthy 2003, 2009; Lorenzoni 2008; Shleifer and Vishny 1992).

7.1. Methodology

In order to assess the impact of neighboring foreclosures on the price of an individual house formula (1) is extended:

$$P_{it} = A_i + T_i + M_t + F_{it-1} + e_{it} \quad (6)$$

The term F_{it-1} is the count of insolvencies in the previous year in the same street. When determining the log difference between the price of the matched pairs the following equation emerges.

$$p_{it} - p_{is} = \tau_{it} - \tau_{is} + m_t - m_s + F_{it-1} - F_{is-1} + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2) \quad (7)$$

The data shows significant skewness in the street length which might affect the significance of the impact of foreclosures on a street level due to the wide geographical dispersion of houses. On long streets, which enter the sample with a proportionally higher amount of transactions when compared with smaller streets, one can expect a decreasing impact of neighboring foreclosures due to the increasing geographic distance between properties. To initially control this hypothesis a dummy for street size was included. Due to the heavy skew of property IDs per street, the 40 largest streets, defined by the unique count of property IDs per street, are tested via a dummy variable. This dummy variable interacts with the foreclosure count on the street level. This results in:

$$p_{it} - p_{is} = \dot{\tau}_{it} - \dot{\tau}_{is} + m_t - m_s + (F_{it-1} * Big40Str_{it} - F_{is-1} * Big40Str_{is}) + (F_{it-1} * nBig40Str_{it} - F_{is-1} * nBig40Str_{is}) + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2) \quad (8)$$

,where the term *Big40Str* represents a dummy that is one for transactions that occur in the 40 largest streets and zero otherwise while the term *nBig40Str* is a dummy that is one for transactions that do not occur in the 40 largest streets and zero otherwise. As these dummies interact with the defaults in the same street on the previous year it disentangles the effect of foreclosures in the previous year on the 40 largest streets and the rest of streets on the price change.

As an additional step I analyze the impact of increasing street sizes by including an interaction variable between street size and previous year foreclosures in formula (7), this leads to:

$$p_{it} - p_{is} = \tau_{it} - \tau_{is} + m_t - m_s + (F_{it-1} * StrLen_{it} - F_{is-1} * StrLen_{is}) + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2) \quad (9)$$

,here the term *StrLen* represents the length of a street measured by the number of unique properties in the sample on the specific street. This allows to test the hypothesis whether spillover effects are a local effect, as in this case with an increasing size of the street spillover effects should become smaller, what would be reflected in the added interaction term.

To control for time variance interaction variables were included in the formula similar to the inclusion of time-dependent dummy as an interaction term in formula (3). This results in the following formula:

$$p_{it} - p_{is} = \dot{\tau}_{it} - \dot{\tau}_{is} + m_t - m_s + (F_{it-1} * t_t - F_{is-1} * t_s) + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2) \quad (10)$$

Additionally, the same variables were regressed on the residuals of formula (2) in a two-stage estimation process:

$$p_{it} - p_{is} = \tau_{it} - \tau_{is} + m_t - m_s + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2) \quad (2)$$

This results in the following three formulas:

$$\varepsilon = F_{it-1} - F_{is-1} + c + \varepsilon_{it} - \varepsilon_{is} \quad (11)$$

$$\varepsilon = (F_{it-1} * t_t - F_{is-1} * t_s) + c + \varepsilon_{it} - \varepsilon_{is} \quad (12)$$

$$\varepsilon = (F_{it-1} * StrLen_t - F_{is-1} * StrLen_s) + c + \varepsilon_{it} - \varepsilon_{is} \quad (13)$$

This represents a simple extension of the OLS method that rules out any noise from a correlation of the dependent variable's error terms with the independent variables. Hence this additional process rules out endogeneity problems in the previous regressions.

7.2. Results

The spillover effect is analyzed via isolating the effect of insolvencies in the same street in the previous year. On the full sample, I find a significant negative spillover effect of foreclosure sales of -0.33% per insolvency in the same street. While the identification of significant spillover effects is in line with previous literature (Daneshvary et al. 2011; Harding et al. 2009; Immergluck and Smith 2006), it differs substantially in terms of economic significance, as the aforementioned literature finds spillover effect of a magnitude between 0.9% to 2.0%.

Table 4: Regression results spillover effects

Formula	(7)	(7)	(7)	(7)	(8)	(8)	(8)	(8)	(8)
Variable	WD	WMRS	EXKWS	INS_Y_BEF	WD	WMRS	EXKWS	INS_t-1 x BIG STREET 40	INS_t-1 X STREET EXL BIG 40
Coefficient	0.010168	0.017988	-0.004854	-0.003331	0.010115	0.017953	-0.004876	-0.002149	-0.006882
Std. Error	0.006069	0.010355	0.003265	0.00158	0.006069	0.010355	0.003265	0.001814	0.003109
z-Statistic	1.675436	1.737113	-1.48672	-2.108222	1.666659	1.733735	-1.493458	-1.184743	-2.21388
Prob.	0.0938	0.0824	0.1371	0.035	0.0956	0.083	0.1353	0.2361	0.0268
Weighted Statistics									
Mean dependent var	-4.11E-07				-4.11E-07				
Sum squared resid	2,119				2,119				
Akaike info criterion	-0.105747				-0.105742				
Hannan-Quinn criter.	-0.09013				-0.090056				
Deviance statistic	0.051461				0.051461				
Pearson statistic	0.051461				0.051461				
S.D. dependent var	0.312732				0.312726				
Log likelihood	2,338				2,339				
Schwarz criterion	-0.056414				-0.056193				
Deviance	2,041				2,041				
Pearson SSR	2,041				2,041				
Dispersion	0.051461				0.051461				
Unweighted Statistics									
Mean dependent var	-0.014261				-0.014261				
S.D. dependent var	0.297361				0.297361				

Formula 7: $p_{it} - p_{is} = \tau_{it} - \tau_{is} + m_t - m_s + F_{it-1} - F_{is-1} + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2)$, with the previously described standard terms of formula (2) and the term INS_Y_BEF, which reflects the insolvencies in the same street in the previous year (represented in the formula as $F_{it-1} - F_{is-1}$). Not reported here are all yearly and monthly dummies, as they are control variables.

Formula 8: $p_{it} - p_{is} = \tau_{it} - \tau_{is} + m_t - m_s + (F_{it-1} * Big40Str_{it} - F_{is-1} * Big40Str_{is}) + (F_{it-1} * nBig40Str_{it} - F_{is-1} * nBig40Str_{is}) + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2)$, with the previously described terms of formula (8) which is complemented by an interaction term for the street size effect included as two dummy for the 40 largest streets [BIG STREET 40] (represented in the formula as $Big40Str_{it}$ and. $-Big40Str_{is}$ respectively) and all other streets [STREET EXCL BIG 40] (represented in the formula as $nBig40Str_{it}$ and. $-nBig40Str_{is}$ respectively). Not reported here are all yearly and monthly dummies, as they are control variables.

Both regression results present the result after the Case and Shiller (1987) adjustment for heteroskedasticity.

As this might be in part explained by very long streets, such as Prinsengracht with 697 unique properties, Keizersgracht with 634 unique properties and Herengracht with 473, in the sample

which should decrease spillover effects, as most literature (Hartley 2014; Lin et al. 2009) describes spillover effects as a highly local phenomenon. In this sample, which is characterized by strong skewness in street sizes, where the average street has 22 unique properties and the median street has 5 unique properties, I controlled for the presence of a street size effect via the inclusion of 2 interaction variables, which disentangle spillover effects in the 40 largest streets and the rest of the streets.

This inclusion leads to the expected results, as the spillover effect of all streets without the 40 largest streets, defined by the number of unique properties on the street, increases in terms of statistical significance and economic significance from 0.33% to 0.69%, while the spillover effect decreases in economic terms for the 40 largest streets alone, from 0.33% to 0.21% and loses its statistical significance.

As this result shows, that the street length significantly impacts the spillover effects, I analyzed the impact of increasing street lengths by the inclusion of an interaction variable. The result shows that every additional property on a street reduced the negative spillover 0.006%. This

Table 4: Regression results spillover effects

Formula	(9)	(9)	(9)	(9)	(9)
Variable	WD	WMRS	EXKWS	INS_t-1	INS_t-1 x Streetsize
Coefficient	0.010577	0.018393	-0.004594	-0.011653	0.0000628
Std. Error	0.006067	0.010352	0.003264	0.002368	0.0000109
z-Statistic	1.743476	1.776703	-1.407477	-4.92149	5.742154
Prob.	0.0813	0.0756	0.1593	0	0
Weighted Statistics					
Mean dependent var	-4.11E-07				
Sum squared resid	2,117				
Akaike info criterion	-0.106528				
Hannan-Quinn criter.	-0.090842				
Deviance statistic	0.051425				
Pearson statistic	0.051425				
S.D. dependent var	0.312665				
Log likelihood	2,355				
Schwarz criterion	-0.056979				
Deviance	2,040				
Pearson SSR	2,040				
Dispersion	0.051425				
Unweighted Statistics					
Mean dependent var	-0.014261				
S.D. dependent var	0.297361				

Formula 9: $p_{it} - p_{is} = \tau_{it} - \tau_{is} + m_t - m_s + (F_{it-1} * StrLen_{it} - F_{is-1} * StrLen_{is}) + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2)$, with the previously described standard terms of formula (7) and an interaction term between the street size (measured by unique properties per street) and foreclosures in the same street in the previous year [INS_t-1 x STREETSIZE] (this interaction is represented by $F_{it-1} * StrLen_{it} - F_{is-1} * StrLen_{is}$). Not reported here are all yearly and monthly dummies, as they are control variables. Both regression results present the result after the Case and Shiller (1987) adjustment for heteroskedasticity.

result is highly significant and in line with previous quantitative findings. These results also confirm the findings of previous literature (Hartley 2014; Lin et al. 2009) in terms of the locality of spillover effects. The high locality is the central argument of Lin et al. (2009) who argue that the spillover effect is driven by the inclusion of foreclosed properties in the building of a valuation multiple, which raises questions about the prevalent valuation methods during the sample period. In order to assess this hypothesis, one would require knowledge about the residential real estate valuation methods prevalent during the sample period. While I am not aware of literature or knowledge about residential real estate valuation methods during the sample period, the second hypothesis that spillover effects are driven by the dis-amenity of having vacated or less maintained houses in the neighborhood (Harding et al. 2012) can serve as a reasonable explanation for the street size effect. As Hartley (2014) identified that the effect arising from the dis-amenity of having foreclosed properties in the neighborhood is close to zero, while large parts of spillover effects can be explained changes in the local supply of properties, this hypothesis is tested by analyzing the time variation of spillover effects. Here one should expect larger spillover effects in times of lower demand, hence in the second phase of the sample, as the impact of increasing supply should be larger when the market is not characterized by a demand overhang. As the sample incorporates multiple times of crises, I expect the spillover effect to be the largest in these times. That would also be in line with the findings of Li (2017) who finds time variation in spillover effects and finds a negative relation between spillover effects and the price development in the market.

The results show that spillover effects have not been significant over the full time-period, this lack of statistical significance is also reflected in the economic magnitude of 0.006% in the period from 1651 to 1700 and 0.6% in the period from 1601 till 1650. After this period one can find two time periods with negative spillover effects that are significant and one time period with positive spillover effects. The periods from 1701 till 1750 and 1801 till 1811, with a negative coefficient of 0.7% and 0.9% respectively, are significant. Both periods can be characterized by a prevailing recession, which in the time period from 1701 till 1750 ended in a residential real estate crisis with a high amount of foreclosure sales but interestingly the period up to that that crisis is characterized by a relatively low share of insolvency transactions with an average of 7% compared to 19% over the total sample period. This characteristic can also be found in the time period from 1801 until 1811 where the average share of insolvency transactions per year is 8%.

Table 5: Regression results time-variation of spillover effects

Formula	(10)	(10)	(10)	(10)	(10)	(10)	(10)	(10)
Variable	WD	WMRS	EXKWS	1601-1650 x INS_t-1	1651-1700 x INS_t-1	1701-1750 x INS_t-1	1751-1800 x INS_t-1	1801-1811 x INS_t-1
Coefficient	0.010222	0.017614	-0.004857	-0.006051	-0.0000643	-0.007465	0.001194	-0.009489
Std. Error	0.00607	0.010357	0.003265	0.009893	0.00275	0.002761	0.003205	0.004497
z-Statistic	1.684181	1.700577	-1.487559	-0.61168	-0.023386	-2.704155	0.372609	-2.109881
Prob.	0.0921	0.089	0.1369	0.5407	0.9813	0.0068	0.7094	0.0349

Weighted Statistics	
Mean dependent var	-4.11E-07
Sum squared resid	2,118
Akaike info criterion	-0.105746
Hannan-Quinn criter.	-0.089856
Deviance statistic	0.05146
Pearson statistic	0.05146
S.D. dependent var	0.312683
Log likelihood	2,342
Schwarz criterion	-0.055551
Deviance	2,041
Pearson SSR	2,041
Dispersion	0.05146

Unweighted Statistics	
Mean dependent var	-0.014261
S.D. dependent var	0.297361

Formula 10: $p_{it} - p_{is} = \dot{t}_{it} - \dot{t}_{is} + m_t - m_s + (F_{it-1} * t_t - F_{is-1} * t_s) + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2)$, with the previously described standard terms of formula (7) and an interaction term between the different time periods and foreclosures in the same street in the previous year (this interaction is represented in the formula by $F_{it-1} * t_t - F_{is-1} * t_s$). Not reported here are all yearly and monthly dummies, as they are control variables. The regression results present the result after the Case and Shiller (1987) adjustment for heteroskedasticity.

Another interesting similarity between both time periods is that they incorporate periods of declining housing market prices, in the time period between 1701 until 1750, one can see consistently falling prices from 1736 until 1750 and in the time period from 1801 till 1811 we can see that the median price decreased from 1950 Gulden in 1801 to 1315 Gulden in 1810 which represents a price decrease of 32%. While the decreasing prices might be an explanation for the increased spillover effects, which would be in line with the findings of Li (2017) and the findings of Hartley (2014) when assuming that the change in supply effectuates a change in price. When looking at the overall house price development one might wonder why the period of 1751 until 1800 has a highly insignificant coefficient for spillover effects. Here my hypothesis is that the time following 1750 with rising residential real estate prices, due to the economic recovery described by de Vries and van der Woude (2007), cause this insignificance. This would mean that the rising prices in that early part of the time period dominate the decreasing prices induced by the consequences of the declaration of the fourth Anglo-Dutch war in 1780 and the connected economic crisis which result into the price development from

1801 till 1811. Summarizing I believe that the described in-period development causes of suppression of spillover effect by the strong price increase over the majority of the time period. In total, the results imply that the change in supply and hence the impact on the overall supply-demand relationship seem to drive the price more than the dis-amenity of having foreclosed properties in the neighborhood as the dis-amenity of foreclosed properties should be independent of the general price development in the residential real estate market.

In order to reflect the definition of Kallberg et al. (2014) another analysis of the time variation of spillover effects was done, the authors define spillover effects as the co-movement of prices that are not attributable to a change in fundamental factors. To reflect that definition the residuals of the Case-Shiller adjusted formula (2) were taken as a dependent variable and regressed on the change of insolvencies on street level in the years preceding the transaction interacting with the previously defined time periods in a 2-step estimation procedure.

Table 6: Regression results spillover effects in residuals

Dependent Variable: RESIDUAL_CS_BASE
Method: Least Squares
Date: 11/20/18 Time: 23:17
Sample: 1 39892
Included observations: 39892

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1601-1650 x INS_t-1	-0.000316	0.009571	-0.033045	0.9736
1651-1700 x INS_t-1	0.001723	0.002547	0.676416	0.4988
1701-1750 x INS_t-1	-0.006825	0.002625	-2.599869	0.0093
1751-1800 x INS_t-1	-2.05E-04	0.003143	-0.065214	0.948
1801-1811 x INS_t-1	-0.01465	0.004293	-3.412561	0.0006
C	0.008877	0.001166	7.611015	0

R-squared	0.000479	Mean dependent var	0.00853
Adjusted R-sc	0.000354	S.D. dependent var	0.230337
S.E. of regres	0.230296	Akaike info criterion	-0.09875
Sum squared	2115.408	Schwarz criterion	-0.097458
Log likelihooc	1975.673	Hannan-Quinn criter.	-0.098341
F-statistic	3.826447	Durbin-Watson stat	2.156876
Prob(F-statist	0.001819		

Formula 2: $p_{it} - p_{is} = \tau_{it} - \tau_{is} + m_t - m_s + \varepsilon_{it} - \varepsilon_{is},\ s < t,\ \varepsilon \sim N(0, \sigma^2)$, which residuals were the dependent variable in:

Formula 12: $\varepsilon = (F_{it-1} * t_t - F_{is-1} * t_s) + c + \varepsilon_{it} - \varepsilon_{is}$, with an interaction term for different time periods and foreclosures in the same street in the previous year (this interaction is represented in the formula by $F_{it-1} * t_t - F_{is-1} * t_s$). The regression results present the result after the Case and Shiller (1987) adjustment for heteroskedasticity.

The results of this regression are congruent in terms of time period significance but differ in terms of economic magnitude, which means that the initial OLS regression is not affected by

potential endogeneity. While the inclusion in the repeat sales regression leads to a spillover effect of 0.95% for the time period from 1801 until 1811 the regression on the residuals leads to a result of 1.46%, while the economic magnitude is 0.1% lower in the time period from 1701 till 1751. Apart from that deviation the regression confirms the previously identified results.
The significant spillover effects might also explain the recognized investor behavior when looking at the crisis from 1743 to 1751. In this time one could see that the most advanced real estate investors, measured by the number of transactions, did not enter into foreclosure sale transactions but purchased properties via normal transactions mostly before the crisis. If they were active in the crisis they mainly purchased via normal transactions. This makes sense when assuming the existence of significant spillover effects of foreclosed properties on normal properties because under the assumption that foreclosure discounts might arise from either lack of maintenance, procedural uncertainty or changed supply-demand relationships, buying properties that are not exposed to these risks at a discount makes intuitive sense.

8. Discussion and contextualization of results

Overall the results do imply that the residential real estate market of Amsterdam during the sample period can be characterized as very efficient. A consistent foreclosure discount cannot be identified over the sample period, which can most likely be explained by a large demand overhang due to the strongly increasing population (de Vries and van der Woude 2007) and the associated price increases, these lead to decreasing foreclosure discounts as described by Zhou et al. (2015). As the analysis of combinations involving foreclosure sales revealed that houses bought via foreclosure sales and sold via normal sales realize lower returns than a return which is realized via two normal sales. This leads to two possible explanations, either the foreclosed properties are bought at a premium or properties that are bought via foreclosure sales experience lower than average price appreciations. Under the first explanation properties that are bought via normal sale and sold via foreclosure sale should realize a significant premium too. As this is not the case the second explanation seems to be more likely, hence one can assume that the quality of foreclosed properties is lower than average, which would mean that a significant foreclosure discount does not represent a market inefficiency but just the result of an appropriate pricing of fundamental differences, this is also in line with previous research that finds that foreclosure discounts are negatively correlated to the quality of the underlying property Zhou et al. (2015). In addition to that foreclosure discounts also seem to reflect the current market dynamics of demand and supply as they are negatively correlated to increases

in prices, usually associated with overhanging demand. As the strong population increase should lead to a significant demand overhang, which can be also seen in the price development the occurrence of significant foreclosure discounts only in times of crisis does not seem surprising. I assume that in periods of demand overhangs, the accessibility of residential real estate dominates the pricing considerations as supply is limited, while in times of more available supply the pricing of secondary factors such as the presumed lower quality, most likely induced by a lack of maintenance, gets priced in. In terms of economic magnitude the results are in line with the results of Clauretie and Daneshvary (2009), who argued that foreclosure discounts of 20% and above are counterintuitive under the assumption of efficient markets, as the identified foreclosure discounts in times of crisis are 2.7% and 3.5%, which seems to support the assumption of efficient real estate markets in Amsterdam during the sample period.

The identified spillover seem to be driven by changes in supply, as they are highly time variant and occur mainly in periods of crisis where the demand is decreased and the supply is increased, this is in line with the findings of previous literature (Hartley 2014) and the demand and supply characteristics of the sample period.

To summarize one can say that the hypothesis of a continuous presence of foreclosure discounts over the full sample period cannot be confirmed, most likely due to the sample-specific demand and supply profile. Opposed to that the presence of time-varying foreclosure discounts in combination with the hypothesis of increasing foreclosure discounts in times of residential estate market crisis is confirmed in the sample.
The presence of significant spillover effects in the sample is confirmed as well, but also the spillover effect is time variant and occurs mainly in times of crisis.

9. Limitations, Future Research & Conclusion

This section will start with an analysis of the limitations of the research conducted in this thesis and continue with identifying the need or potential for future research and ends with a conclusion.

9.1. Limitations

This thesis investigated the residential real estate market of Amsterdam from the 16th to the 19th century and is identifying the presence of foreclosure discounts and spillover effects. This provides new insights into the market efficiency of historic residential real estate markets and the dynamics of foreclosure discounts and spillover effects.

While these insights represent an interesting basis for future research, I acknowledge the strong impact limitations of this research. This is driven by the strong local focus on Amsterdam during a time period, which is not only timewise very distant to today but also in terms of fundamental market characteristics an uncommon sample. The period is dominated by a strong inhabitant increase in Amsterdam (van der Woude 1982), which significantly influences demand and supply dynamics. This effect is balanced by the length of the time period which should counteract the sample-specific strong demand overhang by the inclusion of several residential real estate market crises. While the sample in total reflects several real estate and economic cycles, the period and aerial limitation restrict the impact of the results due to limited generalizability of the results.

In addition to that, the research shows limitations arising from the research design. While the research design allows measuring foreclosure discounts and spillover effects the explanation remains highly indicative and is based on descriptive statistics and correlations. The first attempt to explain foreclosure discounts quantitatively did not result in statistically significant results, limits the here provided explanations to indicative explanations of the results, that are subject to further research. While these indicative explanations present, due to the time limitations in this thesis, the best way to analyze and explain the results of this thesis, they result in a limited usability of the provided explanations.

Next, to that, the hypothesis of delayed maintenance in combination with changes in the supply and demand relation as central drivers of foreclosure discounts is limited by the chosen methodology of repeat-sales regressions. As the data set does not include information about the maintenance status of the transacted property the assumption of constant quality characteristics might be flawed, due to the fact that delayed maintenance is likely to cause deteriorating quality over time.

9.2. Future research

The sample presents a unique opportunity to gain deeper knowledge about historic real estate markets. In order to learn more about the real estate market one should investigate the drivers of the time variation in foreclosure discounts and the time variation of the spillover effect because when the drivers of the time variation are understood, important conclusions can be made on the mechanics of foreclosure discounts today. Here the analysis of drivers of foreclosure discounts seems to be of central importance, especially the quantification of impacts of possible delayed maintenance and changes in supply and demand relations should be further researched, as the results in this thesis are subject to several limitations as described in the previous chapter.

As I have identified that spillover effects are driven by street sizes and hence seem to be a very local effect, identifying the exact location of the properties in the sample to run further analysis on spillover effects seems to offer interesting insights for future research, as an exact location would not only allow increasing the precision when determining the locality of effects but would also allow analyzing market dynamics in different neighborhoods. The identification of different neighborhoods would allow verifying previously found characteristics of spillover effects and foreclosure discounts. As previous literature suggests that spillover effects are a highly local phenomenon, hence the research design using streets to identify the location of individual properties, does not seem to be an ideal solution, the already identified significant spillover effects might increase in terms of economic and statistical significance when increasing the ability to localize properties.

In addition to that the extensive dataset should be used to gain deeper knowledge of the interaction between credit markets and the real estate market, as the sample presents a unique opportunity to use a detailed dataset, which covers a long time period and can be complemented by additional publicly available data sources, this should allow conducting research explaining the dynamics between the credit market, the residential real estate market and foreclosure discounts. In particular, the time variation should be further investigated, as this allows to draw conclusions about the drivers of foreclosure discounts and spillover effects and give recommendations how to improve market efficiencies to avoid the negative economic externalities of foreclosure discounts and associated spillover effects.

The sample offers the opportunity to learn more about the influence of financial markets on real estate markets, as the sample period, covers the emergence of the stock exchanges and the emergence of several financial markets and products. The extensive documentation duties of the time period give interesting insights into how financial markets influenced the real estate markets and foreclosure discounts as the sample allows to have parts of the sample without the impact of financial products and hence disentangle the effect of financial markets in a way which is not possible for a more recent dataset.

9.3. Conclusion

This thesis uses a repeat sales methodology to assess the market efficiency in the residential real estate market of Amsterdam in the golden ages using a unique data set collected by the City Archives of Amsterdam. This analysis is the first analysis using a cross-methodological approach on historical data to enhance the understanding of the pricing dynamics resulting from foreclosure processes in the residential real estate market. It finds time-varying foreclosure discounts and significant negative spillover effects of foreclosing properties in the neighborhood.

Despite the presented limitations and the corresponding need for additional research, this thesis has interesting implications for several streams of literature. In a historical context the finding of no significant foreclosure discounts over the full sample are an interesting finding, as it implies high efficiency of the residential real estate market of Amsterdam in the golden ages and hence indicates that future research of the structuring of the foreclosure processes in Amsterdam in the golden ages to identify optimization potential for the current foreclosure processes. The time variance of foreclosure discounts which has been found in the sample is in line with previous research (Zhou et al. 2015) and seems to be negatively correlated with the house price appreciation in the total residential real estate market. The corresponding regression does not result in statically significant coefficients but the positive interaction coefficient between the price level and the foreclosure discount seem to give a positive indication for this theory. A second regression, which analyzed the combinations of sales extending the basic repeat sales methodology showed that houses which were first sold via a foreclosure process and then in a normal process realized lower returns than houses that were sold in the first and the second transaction via normal sales procedures. In combination with an analysis of individual investor behavior, this analysis of foreclosure combinations led to the

explanation that these foreclosure discounts are most likely reflective of the lower quality or maintenance status of foreclosed properties. These seem to be only secondary as a pricing factor in times of excess demand but become significant for the price determination in times of limited demand, for example in times economic crises, which not only limit demand but also create additional supply. While this explanation is in line with the research and hypothesis of Clauretie and Daneshvary (2009) and Sumell (2009), it is also confirmed by the fact that the combination where the house is purchased via normal sales procedure and sold via foreclosure sale does not generate a premium, hence the discount in the first combination does not seem to be driven from a premium when acquiring foreclosed properties but from a discount in the sales process when the property is sold in a normal process. Hence the argument that in efficient markets foreclosure discounts represent an arbitrage opportunity (Harding et al. 2012) should be questioned, because when the foreclosure discount is a function of the current relationship between demand and supply, as suggested by the link found by Zhou et al. (2015) via identifying the link between foreclosure discounts and price and the quality of the homes, foreclosure discounts do not represent an arbitrage opportunity but are a consequence of the fundamentals of the property and the prevalent market conditions. This market and fundamental based explanation seems to be also reflected in the economic magnitude of the identified in this thesis of 2.7% and 3.5%, that is in line with the argumentation of Clauretie and Daneshvary (2009), which oppose large parts of previous research and state that foreclosure discounts of 20% seem counterintuitive under the assumption of efficient markets. This is confirmed by the statistical results of this thesis.

When analyzing spillover effects during the sample period, the analysis identified spillover effects are of economic [-0.3%] and statistical significance despite the limitations resulting from the research design. This is confirmed when controlling for the effect of long streets on the economic and statistical significance of the results, here one can see that the 40 largest streets in the sample show no significant spillover effect. In a second analysis, where I interact spillover effects with absolute street sizes, I find that the spillover effect is reduced by 0.006% per additional property in the same street. This does not only confirm the limitations of the research methodology but also confirms that spillover effects had in the historic setting the same characteristic of high locality. Analyzing the time variation of such spillover effects confirmed the findings of Li (2017), who finds larger spillover effects in times of depreciating housing markets. This time variation and also implies that the results of Hartley (2014), who finds that spillover effects are driven by changes in supply rather than by the dis-amenity of

having bad quality properties in the neighborhood, are applicable to the residential real estate market of Amsterdam during the sample period too, as a dis-amenity driven effect should be present over the full sample period. The last explanation that spillover effects can be explained by the inclusion of neighboring properties in the neighborhood (Lin et al. 2009), seems to have become more questionable, as this would imply that the valuation of properties has been conducted via the multiple-method during the golden ages in Amsterdam and to my best knowledge we do not have any information about real estate appraisal methods during that time available, hence this subject remains to be further researched.

Overall this thesis offers interesting insights into the market efficiency of real estate markets of Amsterdam during the golden ages, it adds several arguments to the current discussion of foreclosure discounts and their classification as arbitrage opportunity or efficient pricing mechanism and identifies the existence of spillover effects in a historical market setting. The central argument of that thesis is that the phenomenon of foreclosure discounts seem to be mainly a consequence of inherent market dynamics and individual housing characteristics. The same is valid for spillover effects that seem to be driven by market-related supply and demand dynamics rather than by negative externalities of neighboring properties that are foreclosed.

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Appendix

Appendix A: Example of transcribed data entry

Transcribed example of an *ordinaris kwijtschelding*, which formed the largest share of the underlying data. This transcription was done by Korevaar (2018) and stems from the Property transfer act ACA 5065, inv. Nr. 45, 195f.. It describes a transaction of Rembrandt Hermansz in the standardized form.

> *"We, Cornelis van Vlooswijck and Gerrit van Hellemont, aldermen in Amsterdam, write and acknowledge that for us have appeared Christoffel Thys and Jan Beltens as heirs of Pieter Beltens de Jonge, and have sold and remitted to Rembrandt Hermansz a house and yard standing on the Breestraat, over the Sint Anthonis sluice, on the west-side, with a free exit or pass-through to the house of Claes Elias, as has been explained in the acts of remittance about those, and this being the house and yard that is or was next to that of Claes Elias, with the entire wall on the north west side and that of Salvador Rodrigues on the south east side, and reaches from the street until the house and yard that belongs to Bastiaen Jacobsz Kistemaecker. And those that have appeared have already committed to the terms, and the principal has brought Isaac van Beecq and Dirck Dircks Grijp (jointly appeared) as joint guarantors, and each has promised with all their movable property that this house and yard has and will be remitted year and day, as one has promised to do, and to remove older acts. This is what the sellers have each promised, and the principal has also promised to keep the guarantors free from losses under the agreements written above. Entered January 8, 1653."*

Appendix B: Summary statistics of the most relevant variables

Table 7: Summary statistics repeat sales matched data set

	EXKWS	WD	WMRS	EXKWS 1511_1600	EXKWS 1601_1650	EXKWS 1651_1700	EXKWS 1701_1750	EXKWS 1801_1800	EXKWS 1801_1811	EXKWS_1 NORM_2	EXKWS BOTH	NORM_1_EXKWS_2	INS_t-1	INS_t-1 x BIG STREET 40	INS_t-1 X STREET EXL BIG 40	LOG_RET
Mean	-0.043167	-0.023639	-0.007069	0.000000	-0.009952	-0.022285	-0.014589	-0.002005	0.005665	0.092023	0.007596	0.048857	-0.018801	-0.021533	0.002732	-0.014261
Median	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000371
Maximum	1,000,000	1,000,000	1,000,000	0.000000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	8,000,000	8,000,000	6,000,000	3,284,431
Minimum	-1,000,000	-1,000,000	-1,000,000	0.000000	-1,000,000	-1,000,000	-1,000,000	-1,000,000	-1,000,000	0.000000	0.000000	0.000000	-8,000,000	-8,000,000	-6,000,000	-2,426,904
Std. Dev.	0.372855	0.203422	0.119537	0.000000	0.113849	0.239763	0.185962	0.162844	0.120239	0.289063	0.086822	0.215572	0.749184	0.651936	0.368970	0.297361
Skewness	-0.483933	-2,458,144	-3,961,159	NA	-6,481,372	-1,337,261	-2,032,864	-0.427465	3,117,692	2,822,790	1,134,303	4,185,606	-0.291696	-0.549651	0.484336	-0.490368
Kurtosis	6,985,071	2,326,912	6,927,191	NA	7,543,060	1,699,706	2,842,061	3,769,457	6,872,317	8,968,144	1,296,644	1,851,930	1,502,779	2,143,742	4,627,042	7,780,792
Jarque-Bera	27953.58	723054.0	7404502.	NA	8999343.	337537.5	1101580.	2001987.	7244412.	112181.8	27523041	516810.6	241027.7	567043.2	3113683.	39589.17
Probability	0.000000	0.000000	0.000000	NA	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	-1,722,000	-9,430,000	-2,820,000	0.000000	-3,970,000	-8,890,000	-5,820,000	-8,000,000	2,260,000	3,671,000	3,030,000	1,949,000	-7,500,000	-8,590,000	1,090,000	-5,688,850
Sum Sq. Dev	5,545,667	1,650,709	5,700,065	0.000000	5,170,491	2,293,188	1,379,509	1,057,840	5,767,196	3,333,182	3,006,986	1,853,778	22389.90	16954.50	5,430,702	3,527,297
Observations	39892	39892	39892	39892	39892	39892	39892	39892	39892	39892	39892	39892	39892	39892	39892	39892

EXKWS= Execution remissions & onwillige decreeten, WD: willig decreeten, WMRS: Orphan sales, INS_t-1: Insolvencies in the same street in the previous year, BIG 40: 40 largest streets defined by unique property IDs in the sample on the respective street, EXKWS_1 NORM_2: Matched sale with the initial sale being a foreclosure sale and the second sale not being a foreclosure sale, EXKWS BOTH: Matched sale with 2 foreclosure sales, NORM_1 EXKWS_2: First Matched sale with the first sale being a normal sale and second sale being a foreclosure sale, LOG_RET: log difference between first and second sale

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